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Concurrent associations of dimensions of anger with posttraumatic stress, depression, and functional impairment following non-fatal traffic accidents

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ABSTRACT

Background: Anger is associated with dysfunction following potentially traumatic events. It is still unclear to what extent different types of anger are differentially related to poor outcomes. To advance knowledge in this area, the Posttraumatic Anger Questionnaire (PAQ) was designed, measuring anger directed at (i) the justice system, (ii) other people, (iii) the self, (iv) people held accountable for the potential traumatic event, and (v) a desire for revenge to those held responsible. Preliminary evidence shows that these types of anger are distinguishable and differentially associated with posttraumatic stress (PTS). No studies have yet examined whether such findings can be generalized to victims of non-fatal traffic accidents, one of the most common potentially traumatic events.

Objective: This study's aims were (i) to establish if the five-factor structure of the PAQ found in prior studies could be replicated, (ii) to explore whether the intensity of emerging types of anger differed, and (iii) to explore the associations of anger-types with levels of PTS, depression, and functional impairment.

Method: Two-hundred and fifty adults who experienced a traffic accident completed the PAQ and instruments measuring PTS, depression, and functional impairment. They also answered questions about their socio-demographic characteristics and features of the accident.

Results: Confirmatory factor analysis confirmed that the PAQ measures five types of anger. Levels of anger at people held accountable were the highest. Structural equation modelling showed that both anger at others and anger at the self, but not the other three anger types, were associated with PTS, depression, and functional impairment, when controlling for the shared variance between the anger types, socio-demographic variables, and features of the accident.

Conclusions: Findings illustrate the potential importance of considering different types of anger when assessing and treating PTS following traffic accidents.

Asociaciones concurrentes de las dimensiones de ira con estrés postraumático, depresión y deterioro funcional después de accidentes de tránsito no fatales

Antecedentes: La ira se asocia con disfunción después de eventos potencialmente traumáticos. Todavía no está claro en qué medida los diferentes tipos de ira dirigidos a diferentes objetivos se relacionan diferencialmente con malos resultados. Para avanzar en el conocimiento en esta área, se diseñó el Cuestionario de Ira Postraumática (PAQ en su sigla en inglés), que mide la ira dirigida a (i) el sistema de justicia, (ii) otras personas, (iii) uno mismo, (iv) las personas responsables del potencial evento traumático, y (v) un deseo de venganza hacia los responsables. La evidencia preliminar muestra que estos tipos se distinguen y se asocian diferencialmente con el estrés postraumático (PTS en su sigla en inglés). Ningún estudio ha examinado aún si tales hallazgos pueden generalizarse a las víctimas de accidentes de tránsito no fatales, uno de los eventos potencialmente traumáticos más comunes.

Objetivo: Los objetivos de este estudio fueron (i) establecer si la estructura de cinco factores del PAQ encontrada en estudios anteriores podría replicarse, (ii) explorar si la intensidad de los tipos emergentes de ira difería, y (iii) explorar las asociaciones de tipos de ira con niveles de PTS, depresión y deterioro funcional.

Método: Doscientos cincuenta adultos que sufrieron un accidente de tránsito completaron el PAQ e instrumentos que miden PTS, depresión y deterioro funcional. También respondieron preguntas sobre sus características sociodemográficas y características del accidente.

Resultados: El análisis factorial confirmatorio confirmó que el PAQ mide cinco tipos de ira. Los

HIGHLIGHTS
- Based on data from people confronted with a traffic accident, we found the Posttraumatic Anger Questionnaire (PAQ) to represent distinguishable dimensions of anger.
- Anger dimensions were: anger directed at (i) the justice system, (ii) other people, (iii) the self, (iv) people held accountable for the event, and (v) a desire for revenge to those held responsible.
- Scores on items measuring anger at people held accountable for the event were significantly higher than scores on items measuring other anger types.
- Anger at the self and other people were most strongly associated with posttraumatic stress, depression, and functional impairment.

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niveles de ira hacia las personas responsables fueron los más altos. El modelo de ecuaciones estructurales mostró que tanto la ira hacia los demás como la ira hacia uno mismo, pero no los otros tres tipos de ira, se asociaron con PTS, depresión y deterioro funcional, al controlar la varianza compartida entre los tipos de ira, variables sociodemográficas, y características del accidente.

Conclusiones: Los hallazgos ilustran la importancia potencial de considerar diferentes tipos de ira al evaluar y tratar el PTS después de accidentes de tráfico.

非致命交通事故后愤怒维度与创伤后应激、抑郁和功能损伤的同时关联

背景: 愤怒与潜在创伤事件后的功能损伤有关。目前尚不清楚针对不同目标的不同类型的愤怒在多大程度上与不良结果相关。为了推进该领域的知识,设计了创伤后愤怒问卷 (PAQ),测量针对 (i) 司法系统、(ii) 其他人、(iii) 自我、(iv) 对潜在创伤事件负责人的愤怒, 以及 (v) 对被追责者进行报复的愿望。初步证据表明,这些类型是可区分的,并且与创伤后应激 (PTS) 有不同的关联。目前还没有研究考查这些发现是否可以推广到最常见的潜在创伤事件之一——非致命交通事故的受害者。

目的: 本研究旨在(i)确定是否可以重复先前研究中发现的 PAQ 五因素结构,(ii)探索新出现的愤怒类型强度是否不同,以及(iii)探索愤怒类型与 PTS、抑郁和功能损伤水平的关联。

方法: 250 名经历过交通事故的成年人完成了 PAQ 和测量 PTS、抑郁和功能损伤的测量工具。他们还回答了有关其社会人口特征和事故特征的问题。

结果: 验证性因素分析证实 PAQ 测量了五种愤怒。对被追责者的愤怒程度最高。结构方程模型表明,在控制愤怒类型、社会人口变量、和事故特点。结构方程模型显示, 在控制愤怒类型、社会人口变量和事故特征之间的共享方差时,对他人的愤怒和对自己的愤怒与 PTS、抑郁和功能障碍相关,但其他三种愤怒类型无关。

结论: 研究结果说明了在评估和治疗交通事故后PTS 时考虑不同类型愤怒的潜在重要性。

1. Introduction

There is a gradually growing evidence base showing that different types of anger play a role in posttraumatic stress disorder (PTSD) and other negative psychological outcomes after exposure to potentially traumatic events (McHugh, Forbes, Bates, Hopwood, & Creamer, 2012; Orth & Wieland, 2006). For instance, 'anger out' (i.e. the tendency to express anger in verbal or physical ways) and even more so 'anger in' (i.e. the tendency to suppress anger) are both associated with posttraumatic stress (PTS) symptoms (Orth & Wieland, 2006). Moreover, concepts closely connected to the emotional experience of anger, including hostility and aggression, are associated with PTS (Taft, Creech, & Murphy, 2017) and anger longitudinally predicts PTS following exposure to potentially traumatic events (Lommen, Engelhard, van de Schoot, & van den Hout, 2014). Notably, associations between anger and PTS are not just due to the inclusion of anger in the PTSD criteria (McHugh et al., 2012). The critical role of anger in PTS is not only evident from research supporting its role as a predictor of PTS severity. Its importance is also reflected in research pointing at an interconnection between PTS, anger, self-harm, and suicide. Recent research shows that trauma-related anger may instigate non-suicidal self-harm (Cassiello-Robbins et al., 2021) and suicidal ideation (Dillon et al., 2020). Moreover, anger decreases the efficacy of treatment interventions for PTS (Foa, Riggs, Massie, & Yarczower, 1995; Rosen, Adler, & Tiet, 2013).

Theoretical models have connected the interplay of anger with PTS and other maladaptive outcomes among traumatized people with impaired self-control and self-monitoring, rumination about the causes of the traumatic event, and reduced behavioural constraints that may spiral into feelings of explosiveness and rage and aggressive behaviours (McHugh et al., 2012). However, the characteristics of anger associated with PTS are not clear and it remains to be established whether posttraumatic anger is different from non-trauma-related anger (McHugh et al., 2012; Taft et al., 2017). One key issue in this area that needs to be explored further is the relationship between anger directed at different targets and PTS symptoms. Anger may be directed at the self, at persons or institutions held responsible for causing or not preventing the event, but also at people causing secondary stressors in the event's aftermath. To advance knowledge about the role of these different types of anger, Orth and Maercker (2009) developed the Posttraumatic Anger Questionnaire (PAQ). The PAQ is a self-report measure, assessing anger directed at (i) the justice system, (ii) other people, (iii) the self, (iv) people held accountable for the potentially traumatic event (i.e. perpetrators) and, additionally, (v) a desire for revenge to those held responsible. In their preliminary validation study among victims of sexual and non-sexual assault, Orth and Maercker (2009) found that an exploratory factor analysis supported that the PAQ assesses five distinguishable subtypes of anger. Anger at perpetrators was the most common type of anger, and anger directed at perpetrators and self-directed anger were most strongly associated with PTS severity when controlling for the shared variance between the anger subtypes.

In a recent study, Lenferink, Nickerson, Kashyap, De Keijser, and Boelen (in press) used the PAQ to

study associations of anger with emotional outcomes for people who had lost loved ones in fatal traffic accidents. Using confirmatory factor analysis, the five factor structure of the PAQ could be replicated. Results also showed that anger at people held accountable was the most strongly endorsed anger type, whereas anger at the self was most strongly related to both PTS and prolonged grief symptoms. Put differently, anger direct outwards was strongest, yet anger directed inward appeared more detrimental to emotional well-being.

To our knowledge, no further studies have used the PAQ to study how anger subtypes relate to PTS and associated psychological outcomes. At the same time, understanding what forms of anger are particularly detrimental in recovery from psychological trauma has theoretical and clinical relevance. Theoretically, knowledge about the impact of different anger types may inform theorizing about cognitive and behavioural processes implicated in persistent PTS. From a clinical viewpoint, determining which anger types are associated with different outcomes of psychological trauma is paramount to identifying individuals at risk of poor outcomes and, additionally, advances knowledge about potential targets for treatment. Anger and PTS may be particularly relevant to study in people exposed to traffic accidents. That is, traffic accidents are relatively frequent (WHO, 2021) and implicated in the development of PTSD in many people (Heron-Delaney, Kenardy, Charlton, & Matsuoka, 2013). Moreover, traffic accidents and their sequelae commonly involve multiple parties and institutions, implying that there may be multiple sources of frustration and anger.

As mentioned, Lenferink et al. (in press) examined anger in a large sample of people bereaved due to a fatal traffic accident. The current study paralleled that investigation and was designed to examine the associations between different types of anger on the one hand, and levels of PTS, depression, and functional impairment on the other hand, among people who had experienced a traffic accident in which there were either no fatalities or no deaths of people familiar to the participants. We only included participants confronted with accidents that involved other people, leaving out participants involved in unilateral (one-sided) accidents, because the PAQ-based anger types investigated in this study were not all applicable to such unilateral accidents. Specifically, the aim of this study was threefold. First, we aimed to establish if the five-factor structure of the PAQ could be replicated in the current sample. To this end, we subjected scores on the PAQ to confirmatory factor analysis expecting that, in line with prior research (Lenferink et al., in press; Orth & Maercker, 2009), a five-factor model with PAQ items representing five types of anger, would fit our data better than a unidimensional model with all PAQ items loading on one factor. The second aim was to explore whether the relative intensity of emerging types of anger differed. Specifically, provided that the confirmatory factor analysis would indicate that, in our sample, the PAQ assessed distinct dimensions of anger, we planned to compare the scores on these dimensions to find out whether different forms of anger were experienced in the same or different intensity. The third goal was to explore the associations of emerging dimensions of anger with indices of emotional distress and impaired functioning. Specifically, we considered the associations of anger dimensions with PTS, depression, and functional impairment, while taking into account effects of socio-demographic variables and characteristics of the accident associated with these dependent variables. Previous research has identified different correlates of PTS after traffic accidents (e.g. Heron-Delaney et al., 2013); in this study we considered gender, age, education, time elapsed since the accident, transportation type, whether participants were driving the vehicle involved in accident, physical injury, and perceived threat to life.

2. Methods

2.1. Participants and procedure

The current study was part of the Dutch TrafVic project, investigating the psychological impact of (both fatal and non-fatal) traffic accidents for (bereaved and non-bereaved) victims of such accidents (see Lenferink, De Keijser, Eisma, Smid, & Boelen, 2020, 2021). As noted above, this study focused on psychological functioning of people confronted with traffic accidents in which no (familiar) people died. Moreover, participants involved in unilateral accidents were not included, because some of the PAQ items (representing anger toward those held accountable for the event) are not applicable to such accidents. For another study partially based on the same data, see Boelen, Eisma, de Keijser, and Lenferink (2022).

Recruitment took place via announcements on social media, peer support organizations, and university websites, and direct mailing (of contacts held by the Dutch Victim Support organization). Announcements explained the aims of the project and solicited people involved in traffic accidents to participate by completing questionnaires online. People interested in participation could login to a secured online environment (programmed in Qualtrics) where more information about the study was given, informed consent could be provided, and the questionnaire could be completed. The questionnaire was divided into two parts. People had the option to discontinue completion of the questionnaire after part 1. In total, 408 people started filling out the questionnaire. After

removing cases from participants who discontinued completion of the questionnaires after the initial part on sociodemographic and accident-related variables, participants confronted with unilateral (one-sided) accidents, and participants who only completed part 1 but not part 2 (that included the PAQ), data from 250 people were available for the current study. The ethics committee for psychological research from Groningen University approved the study (PSY-1819-S-0113). All participants provided online written informed consent.

2.2. Measures

2.2.1. Sociodemographic and accident-related characteristics

Participants were asked about their gender (dichotomized as 0 = 'male', 1 = 'female'), age (in years), and educational level (multiple categories, collapsed into 0 = 'less than college/education', 1 = 'college/university level'). Participants reported the date of the accident, allowing us to determine the number of months elapsed since the accident, and were asked what transportation type they used during the accident (multiple categories, collapsed into 0 = 'car/motorcycle', 1 = 'other') and whether they were the driver of the vehicle involved in the accident (0 = 'no', 1 = 'yes'). Drawing from prior research (e.g. Delahanty, Raimonde, Spoonster, & Cullado, 2003), perceived threat to life was measured with a single item ('To what extent did you fear for your own life during the traffic accident?') rated on a 7-point scale ranging from 1 ('not at all') to 7 ('a lot'). The question 'Were you physically injured in the accident?' was posed to obtain an index of injury severity, with seven response options (1 = 'no', 2 = 'yes, but no medical attention was required', 3 = 'yes, I obtained treatment from my GP', 4 = 'yes, I obtained treatment at a hospital outpatient clinic', 5 = 'yes, I was hospitalized for 1 night through 2 weeks', 6 = 'yes, I was hospitalized longer than 2 weeks', 7 = 'yes, I was admitted to the intensive care unit'). We collapsed scores into two categories, with scores 1–3 considered as indicating 'not/mildly injured' and scores 4–7 indicating 'moderately/severely injured' (cf. Mayou & Bryant, 2002).

2.2.2. Posttraumatic anger

Posttraumatic anger was assessed with the PAQ, a 20-item measure tapping five subtypes of anger. It was developed and validated in a German-speaking sample of crime victims (Orth & Maercker, 2009). With consent from the developers, the PAQ was translated into Dutch as part of a parallel study from our group (Lenferink et al., in press), using forward–backward translation methods. The instruction and items of the PAQ

were altered such that wording referring to 'assault' were replaced by 'accident'. As noted, it was designed to measure five types of anger, including anger at (i) the justice system (e.g. 'I was angry at the police, courts, or administration because they dealt with me without comprehension'), (ii) other people (e.g. 'I was angry at other people because they did not prevent the accident'), (iii) the self (e.g. 'I was angry at myself because I still feel weak and vulnerable because of the accident'), (iv) perpetrators (e.g. 'I was angry at the perpetrator because he caused so much harm in my life'), and (v) a desire for revenge (e.g. 'I imagined how I will get even with the perpetrator'). All five anger types are assessed with four items. Items are answered on a 6-point Likert scale ranging from 0 ('never') to 5 ('very often'). Cronbach's alpha of the full PAQ in our sample was .93.

2.2.3. Posttraumatic stress symptoms

We used the Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5) to assess PTS symptoms. The PCL-5 is a 20-item measure of symptoms of PTSD as defined in DSM-5 (Blevins, Weathers, Davis, Witte, & Domino, 2015; Dutch version Boeschoten, Bakker, Jongedijk, & Olff, 2014). Participants were instructed to rate how much they were bothered by each symptom in the past month, on 5-point scales ranging from 0 ('not at all') to 4 ('extremely'), with the traffic accident as the anchor event. A cut-off score of > 32 was used for an indication of clinically relevant PTSD levels (Krüger-Gottschalk et al., 2017). Cronbach's alpha in the current sample was .94.

2.2.4. Depression symptoms

Depressive symptoms were assessed with the seven item depression subscale from the Hospital Anxiety and Depression Scale (HADS-D; Zigmond & Snaith, 1983; Dutch version Spinhoven et al., 1997). The HADS-D instructs respondents to rate their experience of different symptoms (e.g. 'I feel as if I am slowed down') on 4-point scales (scored 0 through 3), with different anchors. The HADS-D has good psychometric properties, with scores ≥ 8 indicating clinically relevant depression (Bjelland, Dahl, Haug, & Neckelmann, 2002). Cronbach's alpha in the current study was .91.

2.2.5. Functional impairment

The 5-item Work and Social Adjustment Scale (WSAS) was administered to assess the degree to which participants felt their functioning in the areas of work, home management, social and private leisure activities, and social relations was impaired as a result of the accident. Items were rated on 9-point scales with anchors 0 ('not at all') to 8 ('very severely impaired'). The WSAS has adequate psychometric

properties (Mundt, Marks, Shear, & Greist, 2002). Cronbach's alpha in our sample was .96.

2.3. Statistical analyses

To evaluate the degree of distress in our sample, we compared the severity of PTS and depression in the current sample with established cutoff scores. To be able to control for relevant sociodemographic variables and characteristics of the accident in subsequent analyses, we then examined associations of sociodemographic variables and characteristics of the accident with PTS, depression, and functional impairment levels, using t-test for dichotomized categorical variables and Pearson correlations for continuous variables.

Next, to address our first aim, the factor structure of the PAQ was examined by comparing the fit of a unidimensional model with a multidimensional model using confirmatory factor analysis in Mplus (version 8.0; Muthén & Muthén, 1998-2017). The multidimensional model encompassed five correlated factors representing the five types of anger assessed by the PAQ. Skewness values of the PAQ items were below 3 for all items except item 1, 8, and 18–20 (values up to 4.40); kurtosis values were below 10 for all items except for item 1, 8, 18, and 19 (values up to 15.18). Thus, univariate normality was not supported and robust maximum likelihood estimation was, therefore, used. To evaluate model fit, we considered Akaike information criterion (AIC), Bayesian information criterion (BIC), and Sample size adjusted Bayesian information criterion (SS-BIC) with lower values indicating better with, the Comparative Fit Index (CFI) and Tucker Lewis Index (TLI), with values ≥ 0.90 representing acceptable fit (and values ≥ 0.95 excellent fit), the root-mean-square error of approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR), with values < 0.10 indicating acceptable fit (and values < 0.05 reflecting excellent fit) (cf. Kline, 2011). As recommended (Muthén & Muthén, 2021), for chi-square difference testing, the scaling correction factor under chi-square was used to compare the fit of the one-factor vs. five-factor model. There were no missing values for the 20 PAQ items.

To address our second aim, we used paired t-tests to examine differences in mean scores on emerging anger subscales. To address our third aim, we used structural equation modelling (SEM) to examine associations of emerging latent factors of posttraumatic anger with levels of PTS, depression, and functional impairment. In these analyses, we controlled for socio-demographic and accident-related variables associated with one or more of the outcomes (i.e. the variables associated with PTS, depression, and/or functional impairment).

3. Results

3.1. Associations of sociodemographic and accident-related variables with levels of PTS, depression, and functional impairment

Table 1 shows participant characteristics. Two-thirds of participants were female. The participant's mean age was 34 years. About one in three participants had been to college or university. On average, the accident took place approximately seven years earlier; two thirds of participants were driving the vehicle during the accident and a little over one in five participants had been moderately/severely injured. In total, $n = 32$ (12.8%) scored above the cut-off of 32 on the PCL-5, indicating clinically relevant PTS severity. In addition, $n = 56$ (22.4%) scored above the cut-off of 8 on the HADS-D, indicating clinically relevant depression severity.

We examined if sociodemographic and accident-related characteristics related to levels of PTS, depression, and functional impairment. Outcomes are summarized in Supplementary Table 1 (t-tests) and Supplementary Table 2 (correlations). Age was associated with all outcomes (there were consistently positive correlations between age and outcomes), gender with depression levels (higher scores in men), and education with functional impairment (higher scores among people with higher education). Being physically injured, being a driver of an involved vehicle, and greater perceived threat to life were associated with elevated scores across all three outcomes, transportation type and time since accident were associated with none of the outcomes. Therefore, we controlled for all variables except these latter two in our SEM analyses.

Table 1. Characteristics of participants ($N = 250$).

Variable	Frequency (%) or Mean (SD)
Sociodemographic background variables	
Gender, N (%)	
Male	79 (31.6)
Female	171 (65.4)
Age in years, M (SD), range	33.77 (17.75), 18–80
Level of education, N (%)	
Less than college/university	155 (62.0)
College/university	95 (38.0)
Characteristics of the traffic accident	
Months since accident, M (SD), range [a]	82.10 (111.50), 0–818
Type of transportation during the accident, N (%)	
Car/motorcycle	116 (46.4)
Other	134 (53.6)
Were you driver of the transportation vehicle, N (%) [b]	
No	77 (31.8)
Yes	165 (68.2)
Perceived threat to life (range 1-7), M (SD)	3.47 (2.21)
Were you physically injured in the accident? N (%)	
Not/Mildly injured	194 (77.6)
Moderately/severely injured	56 (22.4)

Note. [a]There were missing values for this variable, total $n = 236$.
[b]There were 8 missing values for this variable, total $n = 242$.

3.2. Dimensionality of the PAQ

The fit indices for the unidimensional model and the five-factor model are shown in Table 2. The unidimensional model showed a poor fit as evidenced by, e.g. low CFI and TLI values and high RMSEA and SRMR values. For the five-factor model, the CFI and TLI values were closer to 0.90, indicating that this model had a better fit to the data. The RMSEA and SRMR were below 0.10 indicating acceptable fit. AIC, BIC, and SS-BIC values also showed that the five-factor model fit better than the one-factor model. Accordingly, the chi square difference test indicated that the five-factor model showed a significantly better fit than the unidimensional model (corrected $\Delta\chi^2 = 2511.24$ (10.64), $p < .001$). Modification indices indicated that the error-terms of the third and fourth 'revenge' items were correlated. This likely stemmed from content overlap of these items. A third model with correlated error-terms for this item-pair fit our data well (Table 2) and fit significantly better than the five-factor model with no correlated errors (corrected $\Delta\chi^2 = 43.59$ (4.28), $p < .001$). The standardized factor loadings for the five-factor model are presented in Table 3. Table 4 shows the mean scores and internal consistencies (Cronbach's alphas) for each subscale, and correlations between factor scores. These correlations varied from $r = .47$ through $r = .66$.[1]

3.3. Differences in intensity of anger scores across the five domains

Paired sample t-test comparing scores of the PAQ subscales showed that anger at the perpetrator was relatively higher than anger at all other sources and revenge; anger at others was stronger than anger at the justice system and a desire for revenge; and self-directed anger was higher than a desire for revenge; all t's > $|3.75|$ all ps < .001.

Table 2. Fit indices factor models Posttraumatic Anger Questionnaire ($N = 250$).

	CFI	TLI	RMSEA (90% CI)	SRMR	AIC	BIC	SS-BIC	Chi square	DF
1-factor model	0.564	0.512	0.124 (0.116 - 0.133)	0.105	14145.33	14353.62	14166.42	824.56	170
5-factor model	0.860	0.834	0.073 (0.063 - 0.082)	0.083	12838.05	13084.56	12862.65	370.29	160
5-factor model correlated errors	0.920	0.904	0.055 (0.044 - 0.065)	0.068	12653.39	12903.41	12678.34	278.92	159

Note. AIC = Akaike information criterion; BIC = Bayesian information criterion; CFI = Comparative Fit Index; CI = Confidence Interval; DF = degrees of freedom; RMSEA = root-mean-square error of approximation; SRMR = Standardized root mean square residual; SS-BIC = Sample size adjusted Bayesian information criterion; TLI = Tucker Lewis Index.

Table 3. Factor loadings five-factor model Posttraumatic Anger Questionnaire ($N = 250$).

		Anger at justice system	Anger at third persons	Anger at self	Anger at perpetrator	Desire for revenge
	I was angry at the police, courts, or administration because …'					
1	… they did not prevent the accident.	.689				
2	… they did not do their work well enough.	.928				
3	… they dealt with me without comprehension.	.905				
4	… they only care about the perpetrators and not the victims.	.802				
	'I was angry at other people because …'					
5	… they did not prevent the accident.		.393			
6	… they treated me badly in the time since the event.		.844			
7	… they did not show understanding for my situation.		.904			
8	… they had the good luck not to become a victim of a accident.		.388			
	'I was angry at myself because …'					
9	… I did not prevent the accident.			.568		
10	… I should have behaved differently when the accident happened.			.584		
11	… I still feel weak and vulnerable because of the accident.			.848		
12	… I cannot cope with the event as well as I would expect myself to.			.907		
	'I was angry at the perpetrator because …'					
13	… he caused so much harm in my life.				.830	
14	… my well-being was so unimportant to him.				.927	
15	… he fails to accept his guilt.				.902	
16	… he behaved badly even in the time after the accident.				.924	
	'I imagined …'					
17	… how the perpetrator would be a victim one day.					.980
18	… how the perpetrator will once really have to suffer.					.829
19	… how I will pay back the perpetrator for what he or she did to me.					.768
20	… how I will get even with the perpetrator.					.699

Table 4. Internal consistency, means (SD), and bivariate associations between subtypes of anger (N = 250).

	α	Means (SDs)	Anger at third persons	Anger at self	Anger at perpetrator	Desire for revenge
Anger at justice system	.89	1.66 (4.03)	.63***	.47***	.56***	.58***
Anger at third persons	.71	2.68 (3.87)		.66***	.65***	.51***
Anger at self	.83	2.21 (3.92)			.48***	.54**
Anger at perpetrator	.94	4.16 (6.24)				.59***
Desire for revenge	.91	1.31 (3.70)				

Note. ** $p < .01$. *** $p < .001$.

3.4. Associations of anger scores with PTS, depression, and functional impairment

In a single SEM, we regressed levels of PTS, depression, and functional impairment on the five latent dimensions of anger. We also included all socio-demographic and accident-related variables associated with one or more outcomes as covariates (all variables we assessed, except transportation type and time since the accident).

Results are summarized in Table 5. Quite consistently, the analyses showed that both anger at other people and anger at the self explained variance in all three dependent variables. Additionally, (greater) threat to life was related to higher PTS severity, (older) age explained related to higher depression severity, and females (vs. males) reported more functional impairment. We reran the model predicting PTS severity excluding one item from the PCL-5 (item 15, 'Irritable behavior, angry outbursts, or acting aggressively') that showed content overlap with the PAQ. The findings did not change meaningfully. Similar significant associations were found with one small change, namely that the association of age with this shortened PCL-5 passed the threshold for significance ($p = .048$); the significance was $p = .051$ for the full PCL-5 (detailed outcomes are available on request).

4. Discussion

The present study was designed to advance our understanding of the associations between different types of anger on the one hand, and levels of PTS, depression, and functional impairment on the other hand, among traffic accident survivors. A first main finding was that confirmatory factor analysis supported that the PAQ measured five associated, but distinguishable forms of anger, including anger at the justice system, third persons, the self, perpetrators, and anger expressed as a desire for revenge. That is, the five-factor model fit significantly better than the unitary model. Notably, fit indices of the five-factor model passed the threshold for adequate model fit, when allowing error terms of two items on 'revenge'—likely stemming from content overlap—to be correlated. Our findings extend prior evidence based on exploratory (Orth & Maercker, 2009) and confirmatory (Lenferink et al., in press) factor analyses and further strengthens the notion that

Table 5. Standardized regression coefficients for structural model including covariates.

	β	SE	p-value
Symptom-levels of posttraumatic stress			
Anger at justice system	-.002	.091	.984
Anger at third persons	.370	.122	.002
Anger at self	.456	.096	<.001
Anger at perpetrator	.106	.095	.261
Desire for revenge	-.085	.080	.289
Age in years	.007	.004	.052
Gender (0 = male, 1 = female)	.056	.096	.558
Education (0 = less than college/university, 1 = college/university)	-.016	.098	.869
Were you physically injured (0 = not/mildly injured, 1 = moderately/severely injured)	-.118	.131	.371
Were you driver of the vehicle (0 = no, 1 = yes)	-.020	.092	.832
Perceived threat to life	.054	.026	.034
Symptom-levels of depression			
Anger at justice system	-.036	.093	.696
Anger at third persons	.425	.120	<.001
Anger at self	.356	.112	.002
Anger at perpetrator	-.121	.096	.207
Desire for revenge	.010	.093	.917
Age in years	.015	.004	<.001
Gender (0 = male, 1 = female)	-.192	.107	.072
Education (0 = less than college/university, 1 = college/university)	-.204	.118	.085
Were you physically injured (0 = not/mildly injured, 1 = moderately/severely injured)	-.094	.154	.541
Were you driver of the vehicle (0 = no, 1 = yes)	-.131	.111	.237
Perceived threat to life	-.011	.028	.694
Functional impairment			
Anger at justice system	-.084	.077	.276
Anger at third persons	.425	.127	.001
Anger at self	.390	.097	<.001
Anger at perpetrator	-.033	.098	.733
Desire for revenge	-.012	.088	.890
Age in years	.021	.089	.205
Gender (0 = male, 1 = female)	.021	.004	<.001
Education (0 = less than college/university, 1 = college/university)	-.053	.112	.639
Were you physically injured (0 = not/mildly injured, 1 = moderately/severely injured)	.158	.158	.316
Were you driver of the vehicle (0 = no, 1 = yes)	-.056	.092	.541
Perceived threat to life	<.001	.027	.994

Note. [a]Two people had missing data on covariates and were excluded from analyses.

anger experienced by individuals exposed to a potentially traumatic event may focus on different targets.

A second main finding was that the summed scores on items measuring anger towards others, perpetrators, and the self in our group of traffic accident victims were higher than scores on items measuring a desire for revenge and anger toward the justice system. It is possible that a desire for revenge may be more common in cases where other persons have intentionally caused harm, such as in violent crimes (Orth, Montada, & Maercker, 2006) or murder (van Denderen, de Keijser, Gerlsma, Huisman, & Boelen, 2014).

That items tapping anger at the justice system were endorsed to a low extent reflects that this type of anger is likely not particularly relevant to this population. This does not, of course, exclude the possibility that other types of events in which the justice system plays a role (e.g. criminal offenses) may give rise to this type of anger more often.

A third main finding was that, apart from being endorsed relatively frequently, both anger at others and anger at the self were most strongly associated with indices of maladjustment. That is, in our SEM analyses, anger at others and anger at the self were uniquely associated with levels of PTS, depression, and functional impairment. The other three anger types tapped by the PAQ were unrelated to these outcomes, when controlling for the shared variance between all anger subtypes plus relevant sociodemographic and accident-related variables (i.e. those related PTS, depression, and/or functional impairment). It is notable that self-directed and other-directed anger (but not the other anger-types) were correlated with all three outcomes; this suggests that these types of anger, but not the other anger-types, are transdiagnostic components of post-traumatic dysfunction.

In a study that was conducted parallel to this study among people who lost loved ones in fatal traffic accidents (Lenferink et al., in press), self-directed anger (as in this sample) and a desire for revenge, but not anger toward others, were associated with elevated PTS severity. Moreover, in that study, anger at the self (but none of the other anger subtypes) was also associated with prolonged grief symptom severity. Thus, a desire for revenge was associated with PTS in those who lost a loved one in a traffic accident (Lenferink et al., in press) but not in non-bereaved survivors of accidents (this study). This may be due to the fact that, in general, fatal road accidents have a more detrimental psychological impact on bereaved people compared to people who are involved in non-fatal accidents. That is, when people lose a loved one in a traffic accident, it is conceivable that the degree to which the perpetrators are convicted and fined is more strongly related to their levels of traumatic stress, than if people did not lose a loved one.

Across both samples, confronted with deadly and non-deadly accidents, the role of self-directed anger stood out. One possible explanation for the detrimental role of self-directed anger in PTS is that, in an attempt to gain a sense of control over what happened, some victims continue to ponder and ruminate about what they themselves could have done differently in order to prevent it (Ehring, Frank, & Ehlers, 2008). This self-focused ruminative thinking possibly fuels self-directed anger, self-blame, and related emotional disturbances common to PTS (e.g. Christ, Contractor, Wang, & Elhai, 2020). Future research should aim to disentangle the direction of longitudinal effects of

such negative self-directed emotions, cognitive processes, and cognitions in relation to psychopathology following preventable stressful life-events such as traffic accidents (cf. Eisma et al., 2021).

Several limitations should be considered when interpreting findings from the present study. First, this was a cross-sectional study precluding conclusions about the direction of the association between anger and PTS, depression, and functional impairment. Longitudinal research is needed to determine whether anger leads to more psychological problems, whether these problems reinforce anger, or whether there is a reciprocal relationship between anger and problems; in light of prior research (e.g. Orth, Cahill, Foa, & Maercker, 2008) a reciprocal relation seems particularly likely. Second, because we did not assess non-posttraumatic, more generic anger, we cannot draw any conclusions about the relative importance of trauma-related and non-trauma anger to mental health after traffic accidents based on this study. Third, as we also stressed in another study based on the same data (Boelen et al., 2022), the present study sample likely represented the general population of traffic accident survivors to a limited degree. That is, many participants were enrolled via universities and all were self-selected yielding an overrepresentation of younger, relatively highly educated people. Moreover, the facts that females were overrepresented in the sample (while males are typically more likely to be involved in accidents; WHO, 2021) and that depression was higher in males than in females (which is typically the other way around; Salk, Hyde, & Abramson, 2017) is also notable. Whilst not precluding the possibility to draw conclusions about the relationships of anger subtypes and PTS, depression, and functional impairment, caution should be applied in generalizing the outcomes to the target population, pending replication of the findings in more diverse samples. Fourth, traffic accidents differ substantially in terms of damage caused and, in the present study, there was quite some variation in accident characteristics. Therefore, one should be careful when connecting the findings of this study to specific types of accidents. Furthermore, findings cannot be generalized to victims of unilateral accidents, considering that these were not considered in the present study.

Notwithstanding these considerations, the current study extends prior evidence that a meaningful distinction can be made between different types of anger following potentially traumatic events. These types are differentially related to problems in adjustment from such events, with anger towards others and the self being most strongly associated with difficulties in adjustment. Our findings have potential clinical implications. Considering prior evidence that anger may fuel self-harm and suicidality (Cassiello-Robbins et al., 2021; Dillon et al., 2020) and reduce the effectiveness

of trauma-focused treatment (Foa et al., 1995; Rosen et al., 2013), our findings suggest that is important to consider anger when assessing and treating PTS following traffic accidents. Identifying the role of self- vs. other-directed anger seems important as self-directed anger is likely to fuel self-destructive behaviours (e.g. self-harm) whereas other-directed anger confers a risk for aggression and interpersonal problems (Taft et al., 2017). Self-directed anger may be targeted by encouraging people to articulate and share negative cognitions about self-reproach, self-blame, and low self-worth fuelling these feelings. Subsequently, these cognitions and feelings can addressed using cognitive restructuring and training anger management skills. Other-directed anger may be mitigated using arousal calming skills and interpersonal skills (Mackintosh, Morland, Frueh, Greene, & Rosen, 2014). It will be important for future studies to continue examining which types of anger are interconnected with PTS and other negative outcomes of potentially traumatic events across different groups and how anger can best be mitigated to prevent its negative consequences.

Note

1. Because several items were negatively skewed, we also compared the fit of a five-factor model and one-factor model using the weighted least square mean and variance adjusted (WLSMV) estimators which does not assume normally distributed variables; with this estimator the five-factor model (e.g., CFI = 0.989, TLI = 0.987, RMSEA = 0.055 (90% CI, 0.044-0.065)) also fit better than the one-factor model (e.g., CFI = 0.953, TLI = 0.947, RMSEA = 0.112 (90% CI, 0.104-0.121)).

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author, PB. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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