

RESEARCH ARTICLE

WILEY

“What if...?”: Vividness and frequency of counterfactual thinking in survivors of terrorism

Andrea Undset^{1,2}  | Tine K. Jensen^{1,2}  | Grete Dyb^{1,3}  |
Tore Wentzel-Larsen^{1,4}  | Ines Blix^{1,5} 

¹Norwegian Centre for Violence and Traumatic Stress Studies, Oslo, Norway

²Department of Psychology, Faculty of Social Sciences, University of Oslo, Oslo, Norway

³Institute for Clinical Medicine, University of Oslo, Oslo, Norway

⁴Centre for Child and Adolescents Mental Health, Eastern and Southern Norway, Oslo, Norway

⁵Oslo New University College, Oslo, Norway

Correspondence

Andrea Undset, Norwegian Centre of Violence and Traumatic Stress Studies, Postbox 181 Nydalen, 0409 Oslo, Norway.
Email: a.b.undset@nkvts.no

Funding information

EkstraStiftelsen Helse og Rehabilitering (Stiftelsen Dam), Grant/Award Number: 2021/FO347321

Abstract

After traumatic experiences, it is common to think about alternative scenarios or outcomes of the event. This is often referred to as counterfactual thoughts (CFT), and CFT after trauma have been associated with posttraumatic stress reactions (PTSR). In this study, we aimed to: (1) investigate the relationship between the vividness and frequency of CFT and PTSR, and to (2) examine the associations between exposure, peri-traumatic reactions, physical injury and the loss of someone close, and the subsequent vividness and frequency of CFT. The participants ($N = 289$) were survivors of a terror attack in Norway. More vivid and frequent CFT were significantly and independently related to more PTSR. Exposure during trauma was significantly associated with more vivid CFT in the unadjusted regression model. No further significant relationships were found between exposure, peri-traumatic reactions, physical injury and the loss of someone close, and the vividness and frequency of CFT. As CFT are common after trauma and potentially cause distress, clinicians should identify and validate CFT, and provide coping assistance.

KEYWORDS

cognition, counterfactual thoughts, posttraumatic stress, PTSD, terrorism, trauma

1 | INTRODUCTION

After a traumatic experience, it is common to experience reactions such as distressing and intrusive memories of the event, heightened reactivity to potential threats, and negative thoughts and emotions relating to the trauma. For most affected individuals, the reactions diminish within the following weeks and months, while others experience persistent posttraumatic stress reactions (PTSR) (Diamond et al., 2022; Galatzer-Levy et al., 2018; Santiago et al., 2013). For some, these can be present decades after the traumatic event (Blix et al., 2018; Morgan et al., 2003). According to Ehlers and Clark's (2000) influential cognitive model of posttraumatic stress disorder (PTSD), trauma reactions are maintained over time by cognitive

processes that produce a persistent “sense of current threat.” Negative appraisals about the trauma and the way the memory is processed are two types of cognitive patterns that have been extensively researched, while less attention has been given to ruminative “what if”-thoughts about how the outcome could have been different or prevented (Ehlers & Clark, 2000). Such thoughts are commonly experienced after trauma (Dalglish, 2004; Teigen & Jensen, 2011).

“What if”-thoughts are thoughts about alternative scenarios or outcomes of an event and are often referred to in the literature as counterfactual thoughts (CFT) (Kahneman & Miller, 1986; Miller & McFarland, 1986). These thoughts can either be upward, where a better outcome is imagined (“If I had only stayed at home that evening, the accident wouldn't have happened”), or downward, where a worse

This is an open access article under the terms of the [Creative Commons Attribution](https://creativecommons.org/licenses/by/4.0/) License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2024 Norwegian Centre for Violence and Traumatic Stress Studies. *Applied Cognitive Psychology* published by John Wiley & Sons Ltd.

outcome is imagined (“If I had not been wearing a helmet when the bicycle accident happened, I could have died or been badly injured”). Upward counterfactuals have been especially associated with preparations for future events, but also with negative affect. Downward CFT have often been associated with thoughts like “at least, it didn’t turn out worse” which are often thought to be comforting (Markman et al., 1993). According to Roese and Epstude’s functional theory of counterfactual thinking (Epstude & Roese, 2008; Roese & Epstude, 2017), counterfactuals are goal-directed thoughts that are typically involved in learning and decision-making. For example, counterfactuals can help us to adjust our behavior based on past experiences (“If I had crashed with that car, I could have been severely injured, next time riding a bike I will use a helmet”). However, past research in clinical psychology has found that CFT also can have implications for mental health (for a review see Epstude & Roese, 2008, and Roese & Epstude, 2017). Moreover, one line of research has found that upward CFT (Blix et al., 2016; Gilbar et al., 2010) and downward CFT (Blix et al., 2016) are related to PTSD after traumatic events.

According to McMullen (1997), CFT can evoke negative affect through two cognitive processes: First, through an affective contrast effect where an imagined better outcome is contrasted with the factual outcome, thus making the factual outcome appear more negative. Second, through an affective assimilation effect where the individual is vividly imagining how it would be or feel if the worst had happened (McMullen, 1997). Thus, CFT after traumatic events could create distress by both evoking negative emotions and thoughts related to how the trauma could have been avoided, and through vivid and disturbing mental images about what could have happened.

The vividness of CFT refers to the level of sensory impressions, the sense of mental time travel, and the level of emotions associated with the imagined scenario (Blix et al., 2018). More vivid thoughts about what could have happened after a traumatic experience may contribute to a stronger sense of here and now or perception of current threat. Empirical studies focusing on vivid trauma-related CFT are scarce, but some have found an association between PTSD and the intrusiveness of CFT (Blix et al., 2016) and vividness of CFT (Blix et al., 2018).

It may not only be the vividness of CFT that causes distress after trauma but also how often a person experiences counterfactuals. According to Roese and Epstude (2017), CFT can become harmful if someone experiences excessive amounts of such thoughts. In line with this, several studies have found support for such an association between a higher frequency of CFT and PTSD after trauma (Blix et al., 2016; El Leithy et al., 2006; Gilbar et al., 2010; Hoppen & Morina, 2021). For example, in a study of physically injured victims of terror attacks, there was a significant association between the frequency of upward CFT and the likelihood of having a diagnosis of PTSD (Gilbar et al., 2010). In another study, El Leithy et al. (2006) investigated how different characteristics of CFT were related to PTSD after experiencing an assault. There was a significant and positive correlation between the frequency of CFT and PTSD (El Leithy et al., 2006).

To our knowledge, only one previous study has investigated the role of both vividness and frequency of CFT in a trauma-exposed sample. In this study, both bereaved and survivors after the fire on the Scandinavian Star ferry in 1990 were asked about the frequency of both upward and downward CFT, and the vividness of their most common counterfactual thought related to the fire, 26 years later. Higher frequency of upward CFT, frequency of downward CFT, and vividness of the most common CFT were independently associated with higher levels of PTSD (Blix et al., 2018).

Despite the emerging support for the association between CFT and psychological distress after trauma, we know little of what increases the risk that trauma-exposed individuals engage in thoughts about what could have happened. Studies conducted within the field of social psychology have found that CFT are more frequent following a more negative outcome (Roese & Epstude, 2017). However, most of these studies have been conducted in laboratory settings, and the question remains whether these findings are transferable to trauma-exposed populations.

To increase our understanding, we examined CFT in a terror-exposed population. On the 22nd of July 2011, a lone terrorist attacked the Labour Party’s youth organization’s annual summer camp at Utøya island in Norway. The shooting lasted for about 1 h and 20 min, where 69 people were killed, and 33 were severely injured. The survivors of the attack were all highly exposed to extreme trauma, with a limited possibility to escape the situation (Dyb et al., 2014; Glad et al., 2021). CFT could be particularly relevant for the survivors of the terrorist attack due to the length of the attack, but also since the official report after the attack stated that the terrorist could have been stopped earlier and thus lives could have been spared (NOU 2012:14). Furthermore, the survivors had to make many decisions during the attack, such as where to run, hide or whether they should try to swim to the mainland (about 600 m).

The aims of the study were twofold. First, we aimed to investigate the relationship between the vividness and frequency of CFT and the level of PTSD. The second aim was to examine the relationship between the degree of exposure, peri-traumatic reactions, physical injury and the loss of someone close, and the vividness and frequency of CFT almost a decade after the attack. We expected to find that a high degree of exposure and peri-traumatic reactions, and physical injury and the loss of someone close were related to both vividness and frequency of CFT. We also hypothesized that more vivid and frequent CFT were associated with higher levels of PTSD.

2 | METHOD

2.1 | Participants

The Utøya study is an open cohort study that has followed the survivors of the terror attack and their parents over four time points, T1 (4–5 months), T2 (14–15 months), T3 (30–32 months), and T4 (8.5–9 years). Since vividness and frequency of CFT were only measured at

T4, the inclusion criteria for the present study were participation at T4. The 289 survivors who participated at T4 were mostly young adults with a mean age of 27.7, 51.2% were female ($N = 148$) and 48.8% were male ($N = 141$). All participants but a small minority (camp members who were on the mainland, $N = 6$) were present on the island at the time of the attack.

2.2 | Procedure

All survivors who were 13 years old and older were invited to join the Utøya study at T1 and T2. At T3, only those who had previously participated at T1 and/or T2 were invited. At T4, all survivors were invited to participate in the study. The participants were interviewed face-to-face by trained interviewers. Informed consent was given by the participants before the interview, and for participants younger than 16 years, consent was given by their parents. The Utøya study was approved by the Norwegian Regional Committee for Medical and Health Research Ethics (document 551224, 2011/1625, 2014/246). A more detailed description of the data collection has been given elsewhere (Dyb et al., 2014; Glad et al., 2021; Stene & Dyb, 2016). The present study was preregistered at Open Science Framework (10.17605/OSF.IO/X4AZ3).

2.3 | Measures

2.3.1 | Vividness of CFT

The vividness of CFT was measured at T4. The participants were first asked whether they had experienced CFT after the terror attack. "After a dramatic episode, one can think about how the episode could have been different or had another outcome. It can be thoughts such as 'if-...' or 'if only-...', and imagining an alternative course of events. Have you had any such 'if-...' thoughts related to the terror attack at Utøya on the 22nd of July?" The participants who confirmed that they had experienced CFT relating to the attack were asked to describe their most frequent CFT. "Can you tell me about the most common thought you have had about what could have happened or how it could have turned out differently?" They were then asked eight questions about how they experienced the thought they had just described. The first six items have previously been used by Blix et al. (2018) to measure the vividness of CFT. In the present study, we included two additional items, measuring changes in mood and arousal, as we believe that such reactions could be closely related to the concept of vividness of CFT. All eight items were based on the Autobiographical memory questionnaire (AMQ) (Boals et al., 2011; Rubin et al., 2003; Rubin et al., 2011). Responses were given on a 7-point scale (1 = "not at all" to 7 = "to a very large extent"). A mean score was calculated using a half rule that requires responses on at least half of the questions for a mean-or sum score to be computed. Internal reliability was high in the present sample ($\alpha = 0.87$).

2.3.2 | Frequency of CFT

The frequency of CFT in the past month was measured at T4. Participants who had given a positive response to having experienced any CFT relating to the terror attack were asked the following question: "How often have such thoughts about what could have happened, or how the situation could have been different appeared in the last month?" Responses were given on a 5-point scale (0 = "never," 1 = "rarely," 2 = "sometimes," 3 = "often," and 4 = "very often"). This single item was the only information available in the data on the frequency of CFT, and thus it was treated as an ordinal variable. The frequency of CFT was measured regardless of the direction of the counterfactuals (upward/downward).

2.3.3 | UCLA PTSD RI

PTSR over the past month were measured at T4, using the University of California at Los Angeles' PTSD Reaction Index (UCLA PTSD-RI) (Steinberg et al., 2004). The measure corresponds to the symptom criteria for DSM 5 (Doric et al., 2019). The UCLA PTSD-RI is a 27-item scale, however, for the Utøya study four items were combined into two, and symptoms of PTSD were measured by 25 items. The eight items measuring criteria D2, D3, and D4 have alternative formulations, and the highest score of the formulations is used. Finally, 20 items are used to calculate the total score. Responses are rated on a 5-point scale (0 = "never," 1 = "two times a month," 2 = "1–2 times a week," 3 = "2–3 times each week," and 4 = "almost every day"). A score of 35 or more on the total severity score indicates high symptom levels (Kaplow et al., 2020). A mean score ranging from 0 to 4 was calculated using a half rule, and the scale demonstrated good internal reliability in the present study ($\alpha = 0.92$).

2.3.4 | Exposure during the event

A checklist with 14 items was developed specifically for the longitudinal Utøya study, to measure exposure during the terror attack (Dyb et al., 2014). Responses were "yes" or "no" (coded "yes" = 1 and "no" = 0), and the measure included questions such as: "Saw someone be injured or killed" and "Saw the terrorist point the gun at him/her or realised that he had shot at him/her." Exposure during the event was included in the interview at T1, or at T2 for those that did not participate in the first data collection. For the present study, 11 items were included (three items measuring reactions during the event were not included in the analyses). A sum score was computed using a half rule, and the scale ranged from 0 to 11.

2.3.5 | Peri-traumatic reactions

Peri-traumatic reactions were measured at T1 by six items. The first five items measured fear, helplessness, horror, confusion, and

dissociation, and were derived from the UCLA PTSD-RI (Steinberg et al., 2004). The last item was a self-made item that measured rapid heart rate. The responses were recorded on a 5-point scale, scored from 0 = “not experienced at all” to 4 = “experienced very much.” The scale included items such as “Were you afraid, or did you think that this was the most frightening experience you have had?” and “Did you feel like what happened was unreal, like if it happened in a movie and not in real life?” A mean score was calculated using a half rule, and internal reliability was close to acceptable ($\alpha = 0.64$).

2.3.6 | Loss

Participants were asked at all four time points if they lost someone close (friend, family, boyfriend/girlfriend) in the terror attack. Two dichotomous variables were computed based on responses across all time points for each participant: Loss of family member/partner (0 = “no,” 1 = “yes”), Loss of close friend (0 = “no,” 1 = “yes”).

2.3.7 | Injury

Severe injury was defined as hospitalization due to physical injury, and the measure was verified by hospital records (Bugge et al., 2015). Self-reported injury that affects daily function was measured at all time points: “Do you have physical injuries from the terror attack that are affecting your daily functioning?”. In the present study, we used data from T4 for self-reported injury. Based on these measures, a variable was created with the following responses: 0 = “no injury,” 1 = “self-reported injury,” and 2 = “severe injury.”

2.3.8 | Demographic variables

The variables age and sex were determined from social security numbers, no self-reported data were included for these variables.

2.4 | Statistical analysis

Of the 289 participants at T4, 49 reported no counterfactuals relating to the terror attack and were therefore not included in the analyses. The continuous outcome variables, PTSR and vividness of CFT, were moderately skewed, with a tail toward the right. The cross-sectional relation between vividness and frequency of CFT and PTSR was investigated using linear regression. A linear regression analysis was also performed to investigate whether exposure during the event, peri-traumatic reactions, physical injury, and loss predicted more vivid counterfactuals. Finally, an ordinal logistic regression analysis was performed with the frequency of CFT as the outcome variable, and exposure during the event, peri-traumatic reactions, physical injury, and loss as predictor variables. Age and sex were included as covariates. There were only missing data for the sum scores of peri-traumatic reactions (18.3% missing) and exposure during the event (13.3%

missing). We handled missing data for the longitudinal analyses with vividness and frequency of CFT as the outcome variable, using multiple imputation with 200 imputations in R package mice (van Buuren & Groothuis-Oudshoorn, 2011). The imputation model was estimated based on the variables that were included in the regression models, and the three additional items for exposure during the event that were not included in the analyses. We used the R packages MASS (Venables & Ripley, 2002) and brant (Schlegel & Steenbergen, 2020) to run the ordinal logistic regression analysis and to test the proportional odds assumption. The Brant-test (Brant, 1990) was conducted on non-imputed data, and the assumption was violated for the full model (omnibus = 0.01), however, none for the included variables could explain the lack of fit of the full model. The analyses were conducted in IBM SPSS 25 and R (R Core Team, 2022).

3 | RESULTS

An overview of descriptive variables for the 289 participants at T4 is given in Table 1.

The variables that were included in the analyses are presented in Table 2. Of the 240 participants that reported to have had CFT about the terror attack, most of them (75%) reported that they rarely or never experienced such thoughts during the past month. However, a substantial minority (25%) reported such thoughts sometimes, often, or very often during the past month. The 240 participants reported a mean score for vividness of CFT of 3.27 (range 1–7, SD = 1.39), the distribution for each item is presented in Table 3.

The cross-sectional linear regression analysis with the level of PTSR as the outcome variable is presented in Table 4. In model 1, the vividness of CFT was entered as a predictor of symptom level, only adjusted for age and sex. The model explained 33% of the variance in PTSR. In model 2, the frequency of CFT in the past month was entered as a predictor of symptom level, only adjusted for age and sex. The model explained 29% of the variance in PTSR and indicates that with every increase in the frequency of CFT compared to not

TABLE 1 Descriptive table ($N = 289$).

Variable	Mean (SD)/ N (%)
Age mean (SD)	27.7 (4.6)
Sex	
Female N (%)	148 (51.2)
Male N (%)	141 (48.8)
PTSR Mean (SD)	1.2 (0.7)
PTSR at least at cut-off (35) for UCLA PTSD-RI N (%)	59 (20.4)
Have experienced CFT related to the terror attack	
Yes N (%)	240 (83)
No N (%)	49 (17)

Abbreviations: CFT, counterfactual thought; PTSR, posttraumatic stress disorder; PTSR, posttraumatic stress reaction.

having experienced CFT in the past month, there is a significant increase in the level of PTSD. In model 3, both frequency and vividness are entered together, adjusted for age and sex. The included predictors account for 41% of the variance in PTSD. Adjusting the two cognitive variables for each other reduces the size of the estimated coefficients to some degree. However, all variables remain significant predictors of PTSD, except having rarely experienced CFT in the past month compared to having experienced no CFT in the past month. The results indicate that both vividness and frequency of CFT are independently associated with PTSD 8.5–9 years post-trauma.

The longitudinal multiple linear regression analysis with the vividness of CFT as the outcome variable is presented in Table 5. When the predictors were entered separately (unadjusted), there was a small but significant effect of a higher degree of exposure during the attack for more vivid CFT 8.5–9 years after the attack. When all predictor variables were adjusted for each other in one multiple regression analysis (adjusted), there was no significant relationship between any of the predictor variables and the vividness of CFT. The longitudinal ordinal logistic regression model with frequency of CFT as the outcome variable is presented in Table 6. There were no significant

relations between any of the included predictor variables and the frequency of CFT, in either the adjusted or unadjusted model.

4 | DISCUSSION

The majority of the survivors who participated in the Utøya study at T4 reported that they had experienced CFT about the terror attack, and some still experienced such thoughts 8.5–9 years later. In the present study, we investigated the relationship between vividness and frequency of CFT after trauma and PTSD, and whether the degree of exposure and peri-traumatic reactions were associated with more vivid and frequent CFT. In line with our first hypothesis, the vividness of the most common counterfactual thought and frequency of CFT during the past month were both significantly associated with higher levels of PTSD. Contrary to our hypotheses, we found no significant associations between the loss of someone close during the attack, physical injury, exposure, and peri-traumatic reactions and higher levels of vividness and frequency of CFT when the predictor variables were adjusted for each other. There was a small but significant effect of a higher degree of exposure during the terror attack for vividness of CFT when the variable was entered alone. In this study, the associations between frequency and vividness of CFT and PTSD were observed 8.5–9 years after the terror attack. Similarly, both vividness and frequency of CFT were strongly associated with PTSD in survivors and bereaved after the fire on Scandinavian Star, 26 years after the incident (Blix et al., 2018). These studies illustrate that trauma-related thoughts and reactions can be highly persistent and strongly associated over time.

4.1 | Vividness and frequency of CFT and PTSD

The present study adds support to previous findings that the frequency (El Leithy et al., 2006; Gilbar et al., 2010; Hoppen & Morina, 2021) and vividness (Blix et al., 2018) of CFT are related to higher levels of PTSD. As in the study by Blix et al. (2018), we found that vividness and frequency of CFT have an independent contribution to levels of PTSD. In the present study, participants were asked about the frequency of CFT regardless of the content or direction (upward / downward) of the CFT, while in Blix et al.'s (2018) study,

TABLE 2 Variables ($N = 240$).

Variable	Mean (SD)/ N (%)
Frequency of counterfactuals last month N (%)	
Never	91 (37.9)
Rarely	89 (37.1)
Sometimes	42 (17.5)
Often	12 (5)
Very often	6 (2.5)
Vividness (1–7) mean (SD) Observed range	3.3 (1.4) 1–7
Exposure (0–11) mean (SD) Observed range	7.4 (2.1) 0–11
Peri-trauma reactions (0–4) mean (SD) Observed range	3.0 (0.8) 0.3–4
Self-reported injury affecting daily function N (%)	13 (5.4)
Injury requiring hospitalization N (%)	11 (4.6)
Loss of close friend N (%)	187 (77.9)
Loss of family/partner N (%)	10 (4.2)

TABLE 3 Distributions for each item of vividness of counterfactual thought, N (%).

“When I think about what could have happened...”	1—never	2	3	4	5	6	7—always
It is like a real episode	99 (41.3)	34 (14.2)	31 (12.9)	24 (10)	27 (11.3)	10 (4.2)	15 (6.3)
I can feel intense emotions	33 (13.8)	42 (17.5)	36 (15)	35 (14.6)	50 (20.8)	20 (8.3)	24 (10)
It is like I can hear what is happening	103 (42.9)	33 (13.8)	29 (12.1)	15 (6.3)	28 (11.7)	13 (5.4)	19 (7.9)
It is like I can see what is happening	17 (7.1)	25 (10.5)	28 (11.7)	40 (16.7)	39 (16.3)	29 (12.1)	61 (25.5)
It is like I can smell what is happening	161 (67.1)	30 (12.5)	14 (5.8)	10 (4.2)	16 (6.7)	5 (2.1)	4 (1.7)
It is like traveling in time	74 (30.8)	35 (14.6)	36 (15)	25 (10.4)	29 (12.1)	21 (8.8)	20 (8.3)
My mood is changing	38 (15.8)	30 (12.5)	48 (20)	28 (11.7)	35 (14.6)	25 (10.4)	36 (15)
I get a physical reaction (heartbeat, felt tense, sweating)	66 (27.5)	43 (17.9)	26 (10.8)	31 (12.9)	24 (10)	23 (9.6)	27 (11.3)

Variable	Coefficient	95% CI	p	R ²
Model 1				0.33
Vividness	0.28	0.22, 0.33	<.001	
Age	−0.02	−0.04, −0.00	.015	
Sex	0.17	0.02, 0.33	.025	
Model 2				0.29
Frequency			<.001	
Very often versus never	1.55	1.04, 2.06	<.001	
Often versus never	1.04	0.67, 1.41	<.001	
Sometimes versus never	0.67	0.44, 0.90	<.001	
Rarely versus never	0.27	0.09, 0.45	.003	
Age	−0.02	−0.04, −0.01	.011	
Sex	0.17	0.02, 0.33	.031	
Model 3				0.41
Vividness	0.20	0.14, 0.26	<.001	
Frequency			<.001	
Very often versus never	1.06	0.57, 1.54	<.001	
Often versus never	0.61	0.25, 0.97	<.001	
Sometimes versus never	0.43	0.21, 0.64	<.001	
Rarely versus never	0.15	−0.02, 0.32	.083	
Age	−0.02	−0.04, −0.01	.012	
Sex	0.16	0.01, 0.30	.035	

Note: All models are adjusted for age and sex (male = 0, female = 1). In models 1 and 2, vividness and frequency are entered separately, in model 3 vividness and frequency are adjusted for each other.

TABLE 4 Linear regression analysis with posttraumatic stress reactions as outcome and vividness and frequency of counterfactual thought as predictors.

TABLE 5 Linear regression analysis with vividness of counterfactual thought as outcome.

	Unadjusted*			Adjusted**		
	Coefficient	95% CI	p	Coefficient	95% CI	p
Exposure	0.11	0.01, 0.20	.026	0.09	−0.01, 0.20	.066
Peri-traumatic reactions	0.01	−0.00, 0.02	.158	0.01	−0.01, 0.02	.320
Loss of family/partner	−0.03	−0.92, 0.86	.947	−0.05	−0.94, 0.85	.916
Loss of close friend	0.05	−0.37, 0.48	.803	−0.05	−0.49, 0.39	.821
Self-reported injury	0.27	−0.52, 1.05	.504	0.07	−0.74, 0.87	.865
Severe injury (hospitalization)	0.58	−0.26, 1.43	.177	0.48	−0.38, 1.33	.271
Age	−0.02	−0.06, 0.02	.363	−0.01	−0.05, 0.03	.607
Sex	0.19	−0.16, 0.55	.280	0.11	−0.26, 0.47	.574

Note: Sex is coded male = 0, female = 1.

*The unadjusted regressions are a series of single regression analyses, where each of the 8 variables are entered alone as a predictor for the vividness of CFT.

**In the adjusted regression model, all 8 predictor variables are entered simultaneously as predictors of the vividness of CFT in one multiple regression analysis.

participants were asked about the frequency of CFT separately for upward and downward CFT. The frequency of CFT was significantly associated with PTSR in both studies, regardless of the direction of the counterfactuals. Studies that have investigated whether the direction of CFT is related to psychological distress have found inconclusive results. Dalglish (2004) suggested, in a discussion of the discrepancy between his and Davis et al. (1995) findings regarding

the direction of CFT, that it might be the frequency and intrusiveness of CFT that is related to elevated symptom levels and not the direction of the CFT. In the present study, having experienced CFT very often, often, and sometimes in the past month, compared to no such thoughts over the past month, was significantly associated with an increase in PTSR. Furthermore, the results indicate that there is a dose-response relationship between CFT and PTSR. CFT have been

TABLE 6 Ordinal logistic regression with frequency of counterfactual thought as outcome.

Variable	Unadjusted*			Adjusted**		
	Odds ratios	95% CI odds ratios	p	Odds ratios	95% CI odds ratios	p
Exposure	1.08	0.95, 1.23	.213	1.07	0.93, 1.23	.337
Peri-traumatic reactions	1.01	0.99, 1.02	.263	1.01	0.99, 1.02	.411
Loss of family/partner	0.73	0.23, 2.30	.590	0.71	0.22, 2.30	.572
Loss of close friend	1.19	0.67, 2.09	.556	1.13	0.63, 2.06	.676
Self-reported injury	1.36	0.49, 3.75	.549	1.11	0.38, 3.24	.844
Severe injury (hospitalization)	1.53	0.47, 5.00	.477	1.34	0.40, 4.46	.629
Age	0.98	0.93, 1.04	.530	0.99	0.94, 1.04	.655
Sex	1.27	0.79, 2.03	.318	1.21	0.74, 1.98	.458

Note: Sex is coded male = 0, female = 1.

*The unadjusted regressions are a series of single regression analyses, where each of the 8 variables are entered alone as a predictor for the frequency of CFT.

**In the adjusted regression model, all 8 predictor variables are entered simultaneously as predictors of the frequency of CFT in one multiple regression analysis.

understood by some researchers as a form of rumination (Roley et al., 2015; Tanner et al., 2013) that can be defined as repeated and unproductive thinking about a particular theme, such as mentally replaying a past event or excessive thinking about one's emotions (Moulds et al., 2020). The results of the present study indicate that ruminative counterfactuals can be particularly associated with distress.

To our knowledge, only the present study and Blix et al. (2018) study have investigated whether there is a relationship between the vividness of CFT and PTSR. In the present study, we found an independent contribution of the vividness of CFT. This finding could imply that it is of importance whether the alternative simulation is experienced as if it were real in contrast to merely an imagined alternative that the factual outcome is compared with. To vividly imagine alternative scenarios of an event could probably be extremely painful and distressing after a life-threatening trauma. An experiential type of thinking could lead to an affective assimilation effect, where the individual imagine how it would be or feel if the worst happened (downward CFT), in contrast to comparing an alternative outcome to the factual outcome (McMullen, 1997). However, the relationship between the vividness of CFT, direction of CFT and experiential types of thinking is not well understood and could be a potential target for future studies.

Distressing, intrusive, and vivid memories of the traumatic event are a central characteristic of PTSD (American Psychiatric Association, 2013), and a line of research has investigated the close link between mental simulations of alternative outcomes and memory (Addis, 2018; De Brigard & Parikh, 2019; Wardell et al., 2022). CFT involves both the recall of memories of past events in life, and constructive thinking, which is similar to thinking about possible future scenarios (De Brigard & Parikh, 2019). Highly vivid and emotional trauma memories can probably contribute to creating "a sense of current threat" (Berntsen et al., 2003), which in turn is thought to be central for maintaining PTSD (Ehlers & Clark, 2000). Vivid counterfactuals could possibly be related to PTSR in a similar way (Blix et al., 2018). The number of studies that have investigated the associations

between the vividness of CFT and PTSR is scarce, and more studies are needed.

4.2 | Predictors of vividness and frequency of CFT

Previous studies have found that people tend to have more CFT after more negative outcomes (Roese & Epstude, 2017). To our knowledge, no previous study has investigated if attributes of the traumatic event and the individuals' reactions during the episode are associated with the level of frequency and vividness of CFT in trauma-exposed populations. Contrary to our hypothesis, we found no significant associations between the loss of someone close in the attack, physical injury, exposure during the event, and peri-traumatic reactions and higher levels of frequency of CFT 8.5–9 years after the terror attack. A higher degree of exposure during the attack was significantly associated with more vivid counterfactuals, however, there were no significant associations between any of the predictor variables for the vividness of CFT when they were entered together. However, this finding emphasizes that the vividness of CFT and frequency of CFT might be separate phenomena, as the two constructs were also independent predictors of PTSR when adjusted for each other.

In the present study, all participants were survivors of a terror attack, and all of them were highly exposed to danger and frightening and disturbing impressions (Dyb et al., 2014; Glad et al., 2021). With such high exposure to potentially traumatizing impressions, there might be other factors that contribute to an increased risk for subsequent CFT, such as individual differences in cognitive and emotional patterns. A few studies have investigated individual differences in cognitive and emotional style and associations with CFT. In one study, CFT were correlated with negative emotionality, boredom proneness, depression, and emotional thinking style (Branch, 2023). In another study, individual differences in cognitive strategies for handling unwanted intrusive thoughts were significantly related to whether a high frequency of CFT persisted over time (El Leithy et al., 2006). Given the association between CFT and psychological distress after

traumatic events, more studies are needed to gain knowledge on what is associated with persistent and distressing CFT after trauma.

4.3 | Strengths and limitations

One of the major strengths of this study is the high participation rate of the survivors after the terror attack at Utøya; 79% of the survivors have participated at least in one of the four measurement waves (Glad et al., 2021), and there was a low degree of missing data. The data included valid measures of severe injury and loss of a family member or partner that were validated against hospital records or checked for consistency over time. Lastly, this was the first study to investigate predictors of vividness and frequency of CFT in a trauma-exposed population.

Some important limitations should also be mentioned. It is important to note that due to the cross-sectional nature of the regression analysis with PTSR as the outcome variable, it cannot be determined whether more frequent or vivid CFT is driving PTSR, whether it is the other way around, or whether it is a reciprocal dynamic relationship between these constructs. Our measures of exposure, the loss of a close friend and self-reported physical injury are measured between 4–5 months and 8.5–9 years following the terror attack and are based on subjective responses that could change across time. Some of the exposure variables were endorsed by a low number of participants, such as the loss of a family member/partner and physical injury, which could have implications for the possibility of detecting significant relationships.

Other characteristics of CFT that we did not measure have been associated with post-trauma psychological distress, and future studies should also adjust for the effect of the intrusiveness of CFT for a more comprehensive understanding of what characteristics of CFT are related to distress after trauma. We did not examine the direction of CFT, and future studies should investigate the association between the frequency and vividness of upward/downward CFT and PTSR. It could also be that the type of counterfactuals that are associated with distress might be different for individual and collective trauma. As noted by Teigen and Jensen (2011), thoughts such as “It could have been me” might be more common after collective trauma, while thoughts like “Why me?” could be more common after individual trauma. Future studies should also investigate whether it is possible to intervene with peoples' counterfactuals. For example, De Brigard and Hanna (2015) have suggested that practicing emotional regulation during episodic counterfactual thinking could be beneficial for memory modifications during therapy. Finally, as this was an observational study, we did not have data on how CFT occurs spontaneously in daily life. Future studies should include diary measures of CFT to increase the ecological validity of the construct.

4.4 | Implications and conclusions

The findings in the present study add to the very limited number of studies that have investigated the association between vividness and

frequency of CFT and PTSR. The finding that both vividness and frequency of CFT are independently related to the level of PTSR highlights the complexity of the phenomenon and calls for future research to further explore the mechanisms and temporal associations that underlie the association between simulations of alternative outcomes and PTSR. The strong relationships between the frequency and vividness of CFT and PTSR that were found in this study and in Blix et al.'s (2018) study, decades after the traumatic event, could have important clinical implications for trauma-exposed individuals. Persistent trauma reactions have severe consequences for the affected individuals and society as a whole, and understanding what maintains and drives the trauma reactions is of great importance both for treatment and prevention. Neither the loss of someone close, physical injury, exposure nor reactions during the attack, when adjusted for each other, were significantly associated with more vivid and frequent counterfactuals. This finding could imply that other factors have a greater impact on the development of frequent and vivid counterfactuals. However, studies of predictors of CFT after trauma are rare, and more studies are needed. In sum, the strong associations between vivid and frequent CFT and PTSR almost a decade after the traumatic event could have implications for treatment. Clinicians and other professionals working with trauma-exposed groups should be aware that it is not only thoughts about what actually happened that can be distressing, but also thoughts about what could have happened can be harmful after traumatic experiences.

ACKNOWLEDGMENTS

We sincerely thank everybody who participated in this study. This study was made possible due to support from the Dam Foundation, the Norwegian Council for Mental Health, and the Norwegian Centre for Violence and Traumatic Stress Studies. Finally, we thank Marianne Skogbrott Birkeland and Alf Børre Kanten for their valuable input on the design of this study.

FUNDING INFORMATION

This study was funded by Foundation Dam (2021/FO347321) and the Norwegian Centre for Violence and Traumatic Stress Studies.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data cannot be made public due to ethical considerations regarding protecting the privacy of the participants and the sensitive nature of the data.

ORCID

Andrea Undset  <https://orcid.org/0000-0003-3342-2712>

Tine K. Jensen  <https://orcid.org/0000-0002-0751-0228>

Grete Dyb  <https://orcid.org/0000-0002-7138-3665>

Tore Wentzel-Larsen  <https://orcid.org/0000-0002-0318-4162>

Ines Blix  <https://orcid.org/0000-0002-1603-6281>

REFERENCES

- Addis, D. R. (2018). Are episodic memories special? On the sameness of remembered and imagined event simulation. *Journal of the Royal Society of New Zealand*, 48(2–3), 64–88. <https://doi.org/10.1080/03036758.2018.1439071>
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed.). American Psychiatric Association.
- Berntsen, D., Willert, M., & Rubin, D. C. (2003). Splintered memories or vivid landmarks? Qualities and organization of traumatic memories with and without PTSD. *Applied Cognitive Psychology*, 17(6), 675–693. <https://doi.org/10.1002/acp.894>
- Blix, I., Kantén, A. B., Birkeland, M. S., Solberg, Ø., Nissen, A., & Heir, T. (2016). Thinking about what might have happened: Counterfactual thinking and post-traumatic stress in individuals directly and indirectly exposed to the 2011 Oslo Bombing. *Applied Cognitive Psychology*, 30(6), 983–991. <https://doi.org/10.1002/acp.3289>
- Blix, I., Kantén, A. B., Birkeland, M. S., & Thoresen, S. (2018). Imagining what could have happened: Types and vividness of counterfactual thoughts and the relationship with post-traumatic stress reactions. *Frontiers in Psychology*, 9(515), 1–8. <https://doi.org/10.3389/fpsyg.2018.00515>
- Boals, A., Hathaway, L. M., & Rubin, D. C. (2011). The therapeutic effects of completing autobiographical memory questionnaires for positive and negative events: An experimental approach. *Cognitive Therapy and Research*, 35(6), 544–549. <https://doi.org/10.1007/s10608-011-9412-9>
- Branch, J. G. (2023). Individual differences in the frequency of voluntary & involuntary episodic memories, future thoughts, and counterfactual thoughts. *Psychological Research*, 87(7), 2171–2182. <https://doi.org/10.1007/s00426-023-01802-2>
- Brant, R. (1990). Assessing proportionality in the proportional odds model for ordinal logistic regression. *Biometrics*, 46(4), 1171–1178. <https://doi.org/10.2307/2532457>
- Bugge, I., Dyb, G., Stensland, S. Ø., Ekeberg, Ø., Wentzel-Larsen, T., & Diseth, T. H. (2015). Physical injury and posttraumatic stress reactions. A study of the survivors of the 2011 shooting massacre on Utøya Island, Norway. *Journal of Psychosomatic Research*, 79(5), 384–390. <https://doi.org/10.1016/j.jpsychores.2015.09.005>
- Dalgleish, T. (2004). What might not have been: An investigation of the nature of counterfactual thinking in survivors of trauma. *Psychological Medicine*, 34(7), 1215–1225. <https://doi.org/10.1017/S003329170400193X>
- Davis, C. G., Lehman, D. R., Wortman, C. B., Silver, R. C., & Thompson, S. C. (1995). The undoing of traumatic life events. *Personality and Social Psychology Bulletin*, 21(2), 109–124. <https://doi.org/10.1177/0146167295212002>
- De Brigard, F., & Hanna, E. (2015). Clinical applications of counterfactual thinking during memory reactivation. *The Behavioral and Brain Sciences*, 38, e5. <https://doi.org/10.1017/S0140525X14000351>
- De Brigard, F., & Parikh, N. (2019). Episodic counterfactual thinking. *Current Directions in Psychological Science*, 28(1), 59–66. <https://doi.org/10.1177/0963721418806512>
- Diamond, P. R., Airdrie, J. N., Hiller, R., Fraser, A., Hiscox, L. V., Hamilton-Giachritsis, C., & Halligan, S. L. (2022). Change in prevalence of post-traumatic stress disorder in the two years following trauma: A meta-analytic study. *European Journal of Psychotraumatology*, 13(1), 2066456. <https://doi.org/10.1080/20008198.2022.2066456>
- Doric, A., Stevanovic, D., Stupar, D., Vostanis, P., Atilola, O., Moreira, P., Dodig-Curkovic, K., Franic, T., Davidovic, V., Avicenna, M., Noor, M., Nussbaum, L., Thabet, A., Ubalde, D., Petrov, P., Deljkovic, A., Antonio, M. L., Ribas, A., Oliveira, J., & Knez, R. (2019). UCLA PTSD reaction index for DSM-5 (PTSD-RI-5): A psychometric study of adolescents sampled from communities in eleven countries. *European Journal of Psychotraumatology*, 10(1), 1605282. <https://doi.org/10.1080/20008198.2019.1605282>
- Dyb, G., Jensen, T. K., Nygaard, E., Ekeberg, Ø., Diseth, T. H., Wentzel-Larsen, T., & Thoresen, S. (2014). Post-traumatic stress reactions in survivors of the 2011 massacre on Utøya Island, Norway. *British Journal of Psychiatry*, 204(5), 361–367. <https://doi.org/10.1192/bjp.bp.113.133157>
- Ehlers, A., & Clark, D. M. (2000). A cognitive model of posttraumatic stress disorder. *Behaviour Research and Therapy*, 38(4), 319–345. [https://doi.org/10.1016/S0005-7967\(99\)00123-0](https://doi.org/10.1016/S0005-7967(99)00123-0)
- El Leithy, S., Brown, G. P., & Robbins, I. (2006). Counterfactual thinking and posttraumatic stress reactions. *Journal of Abnormal Psychology*, 115(3), 629–635. <https://doi.org/10.1037/0021-843X.115.3.629>
- Epstude, K., & Roese, N. J. (2008). The functional theory of counterfactual thinking. *Personality and Social Psychology Review*, 12(2), 168–192. <https://doi.org/10.1177/1088868308316091>
- Galatzer-Levy, I. R., Huang, S. H., & Bonanno, G. A. (2018). Trajectories of resilience and dysfunction following potential trauma: A review and statistical evaluation. *Clinical Psychology Review*, 63, 41–55. <https://doi.org/10.1016/j.cpr.2018.05.008>
- Gilbar, O., Plivazky, N., & Gil, S. (2010). Counterfactual thinking, coping strategies, and coping resources as predictors of PTSD diagnosed in physically injured victims of terror attacks. *Journal of Loss & Trauma*, 15(4), 304–324. <https://doi.org/10.1080/15325020903382350>
- Glad, K. A., Stensland, S., & Dyb, G. (2021). The terrorist attack on Utøya Island: Long-term impact on survivors' health and implications for policy. *Perspectives on Terrorism*, 15(3), 60–74. <https://www.jstor.org/stable/27030882>
- Hoppen, T. H., & Morina, N. (2021). I'd do much better, if only ... counterfactual comparisons related to traumatic life events. *Cognition and Emotion*, 35(2), 409–416. <https://doi.org/10.1080/02699931.2020.1832967>
- Kahneman, D., & Miller, D. T. (1986). Norm theory: Comparing reality to its alternatives. *Psychological Review*, 93(2), 136–153. <https://doi.org/10.1037/0033-295X.93.2.136>
- Kaplow, J. B., Rolon-Arroyo, B., Layne, C. M., Rooney, E., Oosterhoff, B., Hill, R., Steinberg, A. M., Lotterman, J., Gallagher, K. A. S., & Pynoos, R. S. (2020). Validation of the UCLA PTSD reaction index for DSM-5: A developmentally informed assessment tool for youth. *Journal of the American Academy of Child and Adolescent Psychiatry*, 59(1), 186–194. <https://doi.org/10.1016/j.jaac.2018.10.019>
- Markman, K. D., Gavanski, I., Sherman, S. J., & McMullen, M. N. (1993). The mental simulation of better and worse possible worlds. *Journal of Experimental Social Psychology*, 29(1), 87–109. <https://doi.org/10.1006/jesp.1993.1005>
- McMullen, M. N. (1997). Affective contrast and assimilation in counterfactual thinking. *Journal of Experimental Social Psychology*, 33(1), 77–100. <https://doi.org/10.1006/jesp.1996.1313>
- Miller, D. T., & McFarland, C. (1986). Counterfactual thinking and victim compensation: A test of norm theory. *Personality & Social Psychology Bulletin*, 12(4), 513–519. <https://doi.org/10.1177/0146167286124014>
- Morgan, L., Scourfield, J., Williams, D., Jasper, A., & Lewis, G. (2003). The Aberfan disaster: 33-year follow-up of survivors. *British Journal of Psychiatry*, 182(6), 532–536. <https://doi.org/10.1192/bjp.182.6.532>
- Moulds, M. L., Bisby, M. A., Wild, J., & Bryant, R. A. (2020). Rumination in posttraumatic stress disorder: A systematic review. *Clinical Psychology Review*, 82, 101910. <https://doi.org/10.1016/j.cpr.2020.101910>
- NOU 2012:14. (2012). *Rapport fra 22. Juli-Kommisjonen*. Statsministerens kontor <https://www.regjeringen.no/no/dokumenter/nou-2012-14/id697260/>
- R Core Team. (2022). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing <https://www.R-project.org/>
- Roese, N. J., & Epstude, K. (2017). The functional theory of counterfactual thinking: New evidence, new challenges, new insights. *Advances in Experimental Social Psychology*, 56, 1–79. <https://doi.org/10.1016/bs.aesp.2017.02.001>
- Roley, M. E., Claycomb, M. A., Contractor, A. A., Dranger, P., Armour, C., & Elhai, J. D. (2015). The relationship between rumination, PTSD, and

- depression symptoms. *Journal of Affective Disorders*, 180, 116–121. <https://doi.org/10.1016/j.jad.2015.04.006>
- Rubin, D. C., Dennis, M. F., & Beckham, J. C. (2011). Autobiographical memory for stressful events: The role of autobiographical memory in posttraumatic stress disorder. *Consciousness and Cognition*, 20(3), 840–856. <https://doi.org/10.1016/j.concog.2011.03.015>
- Rubin, D. C., Schrauf, R. W., & Greenberg, D. L. (2003). Belief and recollection of autobiographical memories. *Memory & Cognition*, 31(6), 887–901. <https://doi.org/10.3758/BF03196443>
- Santiago, P. N., Ursano, R. J., Gray, C. L., Pynoos, R. S., Spiegel, D., Lewis-Fernandez, R., Friedman, M. J., & Fullerton, C. S. (2013). A systematic review of PTSD prevalence and trajectories in DSM-5 defined trauma exposed populations: Intentional and non-intentional traumatic events. *PLoS One*, 8(4), e59236. <https://doi.org/10.1371/journal.pone.0059236>
- Schlegel, B., & Steenbergen, M. (2020). *Brant: Test for parallel regression assumption. R package version 0.3-0*. <https://CRAN.R-project.org/package=brant>
- Steinberg, A. M., Brymer, M. J., Decker, K. B., & Pynoos, R. S. (2004). The University of California at Los Angeles post-traumatic stress disorder reaction index. *Current Psychiatry Reports*, 6(2), 96–100. <https://doi.org/10.1007/s11920-004-0048-2>
- Stene, L. E., & Dyb, G. (2016). Research participation after terrorism: An open cohort study of survivors and parents after the 2011 Utøya attack in Norway. *BMC Research Notes*, 9(57), 1–10. <https://doi.org/10.1186/s13104-016-1873-1>
- Tanner, A., Voon, D., Hasking, P., & Martin, G. (2013). Underlying structure of ruminative thinking: Factor analysis of the ruminative thought style questionnaire. *Cognitive Therapy and Research*, 37(3), 633–646. <https://doi.org/10.1007/s10608-012-9492-1>
- Teigen, K. H., & Jensen, T. K. (2011). Unlucky victims or lucky survivors?: Spontaneous counterfactual thinking by families exposed to the tsunami disaster. *European Psychologist*, 16(1), 48–57. <https://doi.org/10.1027/1016-9040/a000033>
- van Buuren, S., & Groothuis-Oudshoorn, C. G. M. (2011). Mice: Multivariate imputation by chained equations in R. *Journal of Statistical Software*, 45(3), 1–67. <https://doi.org/10.18637/jss.v045.i03>
- Venables, W. N., & Ripley, B. D. (2002). *Modern applied statistics with S* (4th ed.). Springer <https://www.stats.ox.ac.uk/pub/MASS4/>
- Wardell, V., Grilli, M. D., & Palombo, D. J. (2022). Simulating the best and worst of times: The powers and perils of emotional simulation. *Memory*, 30(9), 1212–1225. <https://doi.org/10.1080/09658211.2022.2088796>

How to cite this article: Undset, A., Jensen, T. K., Dyb, G., Wentzel-Larsen, T., & Blix, I. (2024). “What if...?”: Vividness and frequency of counterfactual thinking in survivors of terrorism. *Applied Cognitive Psychology*, 38(1), e4176. <https://doi.org/10.1002/acp.4176>