





If only... a systematic review and meta-analysis of social, temporal and counterfactual comparative thinking in PTSD

Thole H. Hoppen , Inga Heinz-Fischer and Nexhmedin Morina 

Institute of Psychology, University of Münster, Münster, Germany

ABSTRACT

Comparative thinking is ubiquitous in human cognition. Empirical evidence is accumulating that PTSD symptomatology is linked to various changes in social, temporal and counterfactual comparative thinking. However, no systematic review and meta-analysis in this line of research have been conducted to this date. We searched titles, abstracts and subject terms of electronic records in PsycInfo and Medline from inception to January 2019 with various search terms for social, temporal and counterfactual comparative thinking as well as PTSD. Journal articles were included if they reported a quantitative association between PTSD and social, temporal and/or counterfactual comparative thinking in trauma-exposed clinical or sub-clinical samples. A total of 36 publications were included in the qualitative synthesis. The number of publications on the association between PTSD and social and temporal comparative thinking was too scarce to warrant a meta-analytic review. A narrative review of available literature suggests that PTSD is associated with distortions in social and temporal comparative thinking. A meta-analysis of 24 independent samples ($n = 4423$) assessing the association between PTSD and the frequency of counterfactual comparative thinking yielded a medium to large positive association of $r = .464$ ($p < .001$, 95% $CI = .404; .520$). Higher study quality was associated with higher magnitude of association in a meta-regression. Most studies collected data cross-sectionally, precluding conclusions regarding causality. Overall, study quality was found to be moderate. More longitudinal and experimental research with validated comparative thinking measures in clinical samples is needed to acquire a more sophisticated understanding of the role of comparative cognitions in the aetiology and maintenance of PTSD. Comparative thinking might be a fruitful avenue for a better understanding of posttraumatic reactions and improving treatment.

Si tan solo ... una revisión sistemática y meta-análisis del pensamiento comparativo social, temporal y contrafactual en el TEPT

El pensamiento comparativo es omnipresente en la cognición humana. Se está acumulando evidencia empírica de que la sintomatología del TEPT está vinculada a varios cambios en el pensamiento comparativo social, temporal y contrafactual. Sin embargo, ninguna revisión sistemática y meta-análisis en esta línea de investigación se ha llevado a cabo hasta la fecha. Se realizaron búsquedas en títulos, resúmenes y términos de materia de registros electrónicos en PsycInfo y Medline desde el inicio hasta enero de 2019 con varios términos de búsqueda para el pensamiento comparativo social, temporal y contrafactual, así como para TEPT. Se incluyeron artículos de revistas si reportaban una asociación cuantitativa entre el TEPT y el pensamiento comparativo social, temporal y/o contrafactual en muestras clínicas o subclínicas expuestas a traumas. Se incluyeron un total de 36 publicaciones en la síntesis cualitativa. El número de publicaciones sobre la asociación entre el TEPT y el pensamiento comparativo social y temporal era demasiado escaso como para justificar una revisión meta-analítica. Una revisión narrativa de la literatura disponible sugiere que el TEPT está asociado con distorsiones en el pensamiento comparativo social y temporal. Un meta-análisis de 24 muestras independientes ($n = 4423$) que evalúa la asociación entre el TEPT y la frecuencia del pensamiento comparativo contrafactual arrojó una asociación positiva de mediana a grande de $r = .464$ ($p < .001$, $IC 95\% = .404; .520$). Una mayor calidad de estudio se asoció con una mayor magnitud de asociación en una metarregresión. La mayoría de los estudios recopilaron datos de forma transversal, lo que excluye conclusiones sobre la causalidad. En general, la calidad del estudio fue moderada. Se necesita más investigación longitudinal y experimental con medidas validadas de pensamiento comparativo en muestras clínicas para adquirir una comprensión más sofisticada del papel de las cogniciones comparativas en la etiología y la mantención del TEPT. El pensamiento comparativo podría ser una vía fructífera para una mejor comprensión de las reacciones postraumáticas y mejorar el tratamiento.

ARTICLE HISTORY

Received 30 August 2019
Revised 6 February 2020
Accepted 10 February 2020

KEYWORDS

Comparative thinking; comparison; social comparison; temporal comparison; counterfactual thinking; counterfactual comparison; mental simulation; PTSD; meta-analysis

PALABRAS CLAVE

comparación contrafactual; pensamiento contrafactual; comparación social; comparación temporal; pensamiento comparativo; simulación mental; TEPT; meta-análisis; comparaciones; trauma

关键词

反事实比较; 反事实思维; 社会比较; 时间比较; 比较思维; 心理模拟; PTSD; 元分析; 比较; 创伤

HIGHLIGHTS

- A narrative review of available literature suggests that PTSD is associated with distortions in social and temporal comparative thinking.
- A meta-analysis of 24 samples ($n = 4423$) yielded a medium to large positive correlation between PTSD severity and the frequency of counterfactual comparative thinking.
- Higher study quality was associated with stronger linear association.
- Most studies were conducted cross-sectionally precluding claims regarding causality.
- Comparative thinking might be a fruitful avenue for a better understanding of the aetiology and maintenance of PTSD.

“要是...多好！”——对PTSD中社会、时间和反事实比较思维的系统综述和元分析

比较思维在人类认知中无处不在。经验证据累计表明，PTSD症状学与社会，时间和反事实比较思维的不同变化有关。然而，到目前为止，这一研究领域尚未进行系统综述和元分析。我们使用不同针对社会，时间和反事实比较思维以及PTSD的搜索词，搜索了PsycInfo和Medline中从最初到2019年1月电子记录的标题，摘要和关键词。纳入报告了创伤暴露临床或亚临床样本中PTSD与社会，时间和/或反事实比较思维之间定量关联的期刊文章。36篇文献被归入定性综合。关于PTSD与社会和时间比较思维之间关联的文献数量太少，不足以进行元分析。对现有文献的叙述性综述表明，PTSD与社会和时间比较思维扭曲有关。对24个独立样本 ($n = 4423$) 进行元分析，评估PTSD与反事实比较思维频率之间的关联，得出 $r = .464$ ($p < .001$, 95% CI = .404-.520) 这一中等到较高程度的正相关。在元回归中，较高的研究质量与较高的关联度相关。大多数研究都采用横断面收集的数据，阻碍了得到因果关系的结论。总体而言，发现研究质量中等。要对比较认知在PTSD病因学和维持中的作用有更深入的了解，需要更多临床样本中有对比较思维经过验证测量的纵向及实验研究。比较思维也许是更好地了解创伤后反应并改善治疗的有效途径。

Comparative thinking is ubiquitous in human cognition and influences our well-being (Mussweiler, 2003; Summerville & Roese, 2008). To make sense of the world around us and derive basic judgements about one's own mental or physical attributes, we frequently compare ourselves with one another (i.e. social comparative thinking), with our memorized past selves or imagined future selves (i.e. temporal comparative thinking) or with a mentally simulated alternative to reality (i.e. counterfactual comparative thinking).

In social comparative thinking, a target that represents a mental or physical attribute is compared to one or more social standards (i.e. attributes of other human beings, Festinger, 1954). For instance, I may compare my own physical appearance with the physical appearance of a friend of mine. Similarly, in temporal comparative thinking, a present self-description is compared with a previous or anticipated attribute of the self (Albert, 1977). For instance, I may compare my current physical strength with my physical strength 5 years ago. Finally, in counterfactual comparative thinking, an actual state of affairs is compared to a hypothetical status in a two-step process. Firstly, a counterfactual alternative to reality is created by mental simulation (Dunning & Madey, 1995; Markman, Gavanski, Sherman, & McMullen, 1993). Secondly, the generated counterfactual alternative is compared to reality. For instance, I may think about my current job dissatisfaction and imagine how I would have a higher job satisfaction nowadays if only I had chosen a different career path. The standard in any comparative thought can either be inferior (i.e. *downward comparison*), superior (i.e. *upward comparison*), or equal to the target (i.e. *lateral comparison*) and the evaluation of the target can then be either contrasted away from the standard (i.e. *contrast effect*) or pulled towards it (i.e. *assimilation effect*, Summerville & Roese, 2008). For instance, if the evaluation of my physical strength becomes more favourable after comparing myself to a worse-off friend, then I am experiencing a contrast effect (i.e. contrasting to a downward social comparison).

If the evaluation of my physical strength, however, becomes more favourable after comparing myself to a stronger friend, then I am experiencing an assimilation effect (i.e. assimilating to an upward social comparison). Comparative thinking serves important psychological functions such as self-evaluation, self-enhancement, or future action planning (e.g. Albert, 1977; Festinger, 1954; Roese, Epstude, & Olson, 2017; Wood, 1989). In light of their commonalities, Markman and McMullen (2003) proposed an integrative framework for social, temporal and counterfactual comparative thinking, the *Reflection and Evaluation Model* (REM). The REM proposes two distinct modes of mental simulation termed reflection and evaluation. *Reflection* is described as an experiential ('as if') mode of thinking that occurs when the information about the standard is included in one's self-construal, fostering standard-consistent, highly accessible cognitions about the self and thereby yielding affective assimilation. Evaluation is described as an evaluative mode of thinking in which information about a standard serves as the reference point against which one's current self-construal is evaluated, thereby excluding information about the given standard from the self-construal and yielding affective contrast.

Moreover, it is known that multiple comparisons standards are simultaneously relevant for coping after adverse health events such as artery surgery (King, Clark, & Friedman, 1999) or in elderly's self-evaluations on health status (Suls, Marco, & Tobin, 1991). Psychological research on comparative thinking has focused mostly on social comparative thinking. Yet, all three kinds of comparative thinking have received little focus in the field of psychotraumatology.

Cognitive theories of post-traumatic stress disorder (PTSD) point towards impaired cognitive processes in the aetiology as well as maintenance of PTSD (Brewin, Dalgleish, & Joseph, 1996; Ehlers & Clark, 2000). Olson, Buhmann, and Roese (2000) proposed three main triggers that may activate counterfactual thoughts: negative events, outcome closeness, and unexpectedness of the outcome. Traumatic

experiences, as highly salient, negative, often unexpected situations, can be assumed to result in increased counterfactual comparative thinking. In line with this notion, Kahneman and Miller (1986) norm theory suggests that counterfactual thoughts are more readily available in response to abnormal events as compared to normal events and that emotional reactions triggered by an event are amplified if counterfactual alternatives are salient (i.e. emotional amplification hypothesis).

Based on Festinger (1954) social comparison theory and Albert (1977) temporal comparison theory, the need for precise self-evaluation is especially high in individuals experiencing high uncertainty about the self (Butzer & Kuiper, 2006; Gibbons & Buunk, 1999). Buunk and Gibbons (2005) suggested that a *typical comparer* is characterized by high uncertainty about the self and negative affectivity. Since PTSD symptomatology is often associated with a shaken self-concept (Ehlers & Clark, 2000; Keshet & Gilboa-Schechtman, 2017) and involves high levels of negative affectivity (American Psychiatric Association, 2013), individuals with PTSD can be expected to frequently engage in social and temporal comparative thinking. In sum, specific as well as overarching theories (e.g. REM) of social, temporal and counterfactual comparative thinking suggest that traumatic events, as salient negative experiences often leading to high levels of uncertainty about the self, may lead to frequent comparative thinking. The current article aims at (1) giving a comprehensive overview of the literature on the relationship between PTSD and social, temporal and counterfactual comparative thinking and (2) analysing the magnitude of association by means of a meta-analysis while taking study quality into account. To the best of our knowledge, this is the first systematic review and meta-analysis in this line of research.

1. Method

1.1. Eligibility criteria

The aims and methods of the meta-analysis were registered with the PROSPERO database (<http://www.crd.york.ac.uk/prospero>). To be considered eligible, publications had to report (1) PTSD symptom severity among individuals exposed to potentially traumatic events or belonging to a high-risk group (e.g. firefighters) and (2) a quantitative association between PTSD symptom severity and at least one of the three comparative thinking types (i.e. social, temporal or counterfactual comparative thinking). Lastly, (3) sufficient data to compute effect sizes had to be reported or provided via email on request.

1.2. Information sources and search strategy

Following the PRISMA guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009), we conducted the literature search in PsycInfo and Medline from inception to 14th of January 2019. The search was conducted in titles, abstracts and subject terms using the search terms outlined in Figure 1. Social comparative thinking has been studied in various disciplines and is widely accepted as a psychological construct (Buunk & Gibbons, 2005). Research on counterfactual and temporal comparative thinking, however, is more limited and concepts are less clearly defined (El Leithy, Brown, & Robbins, 2006; Redersdorff & Guimond, 2005). To capture all relevant publications, a variety of key words were introduced for counterfactual or temporal comparative thinking. We included various constructs that revolve around counterfactual thinking (i.e. counterfactual thinking, thoughts of regret, wishful thinking and thoughts of undoing). While these constructs are labelled quite differently, they share the common denominator of assessing the frequency of counterfactuals revolving around past events rather than prospective events. Finally, we added *mental simulation* as this search term has been linked to all three types of comparative thinking (Markman & McMullen, 2003). All included search terms can be found in Figure 1.

1.3. Study selection

Titles and abstracts of all hits were screened by one author (IHF) based on the abovementioned eligibility criteria. Potentially eligible studies were discussed among all three authors in regular meetings. Full texts of potentially eligible reports were examined thoroughly and independently by two authors (THH & IHF). To extract potential further eligible publications, reference sections of all eligible publications as well as related meta-analyses (i.e. Broomhall, Phillips, Hine, & Loi, 2017; Gerber, Wheeler, & Suls, 2018) and systematic reviews (i.e. Byrne, 2016; Epstude & Roese, 2008; Kahneman & Miller, 1986; Kangas, Henry, & Bryant, 2002; Markman & McMullen, 2003; Mussweiler, 2003; Roese et al., 2017; Taylor & Lobel, 1989) were screened independently by two authors (THH & IHF). A thorough description of the article synthesis is reported in the results section. Regular meetings were held by all three authors to discuss disagreements and remaining uncertainties.

1.3.1. Data collection process

Descriptive information as well as all relevant data of each eligible study was noted down in a coding protocol that we developed for the purposes of the present article. If relevant data were not available in the article, the

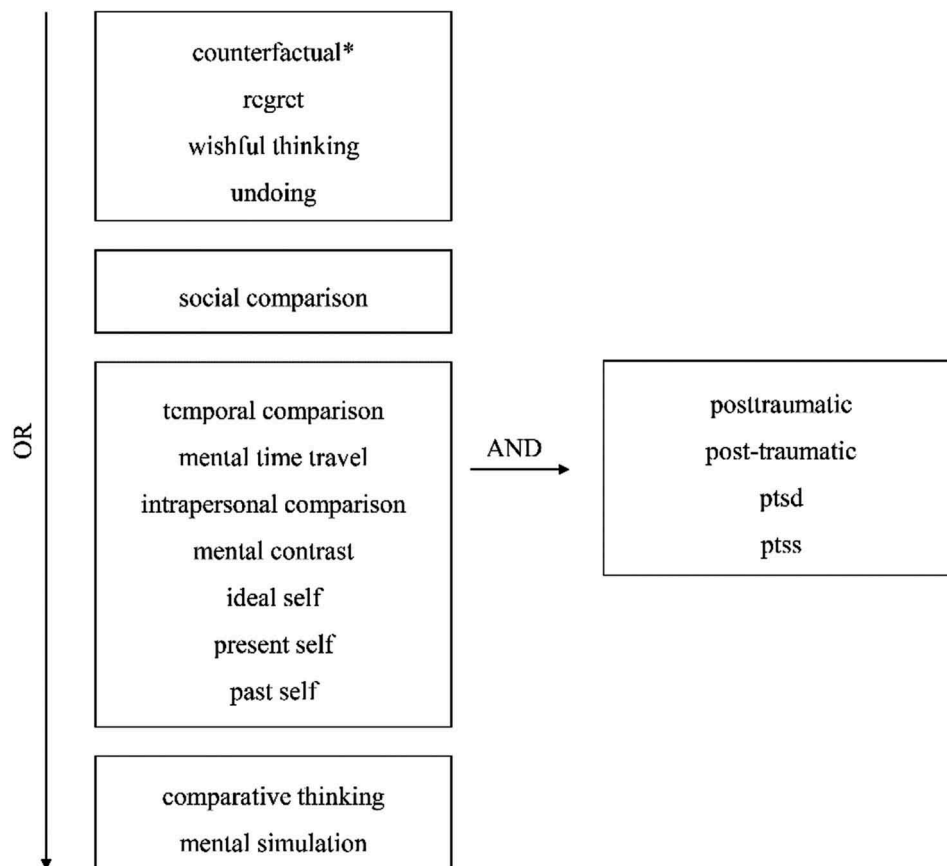


Figure 1. Included search terms for the systematic literature search.

corresponding author of the respective study was contacted via email. A follow-up email was sent 1 month later in case no response was received by then.

1.3.2. Risk of bias in individual studies

To assess the risk of bias for individual studies, study quality was independently assessed by THH and IHF with a 5-item scale developed for the present purposes (see Table A1 in the Appendix). Due to the narrow focus of our systematic review and meta-analysis, we created quality criteria ourselves rather than relying on standardized available options. This decision will be critically scrutinized in the discussion section. Studies could obtain the highest quality scores when (a) the majority of the included sample (i.e. >80%) had a valid diagnosis of PTSD, (b) PTSD diagnosis was assessed with a structured psychiatric interview based on DSM or ICD criteria, (c) PTSD symptom severity was assessed with a validated instrument, (d) the comparative thinking measure was assessed with a validated instrument, and (e) the comparative thinking measure took directions of comparison (i.e. upward and downward) into account. We set the lowest possible quality score for each item at 0 and the highest score at 2, yielding a possible range from 0 to 10 for the study quality sum score. Interrater reliability was excellent, $ICC(3,k) = .85$ (Cicchetti, 1994; Shrout & Fleiss, 1979). Remaining disagreements were resolved through

discussion among all three authors until full agreement was reached.

1.3.3. Summary measures

The chosen summary measure for the meta-analysis was based on the search results. We planned to analyse all quantitative association between social, temporal and/or counterfactual comparative thinking and PTSD symptomatology with a sufficient amount of studies warranting meta-analytic review. However, the only quantitative association with a sufficient amount of studies was the Pearson's correlation between counterfactual comparative thinking frequency (i.e. various constructs as explained below) and PTSD symptom severity.

1.3.4. Main analysis

Random-effects meta-analyses were conducted using the metafor package in R (Viechtbauer, 2010). One study reported separate correlations between the Counterfactual Thinking subscale of the Ruminative Thought Style Questionnaire (CFT-RTSQ) and each of the four subscales of the PTSD Symptom Scale (PSS; Claycomb, Wang, Sharp, Ractliffe, & Elhai, 2015). For this study, we conducted a prior fixed-effects meta-analysis in an effort to yield an overall correlation between CFT-RTSQ and PSS, which was used in the main analysis (see Table A2 in the Appendix).

1.3.5. Risk of bias across studies

Due to the inclusion of various overlapping counterfactual comparative thinking constructs as well as various levels of trauma-exposure and PTSD levels in the included samples we expected substantial heterogeneity between studies and used restricted maximum likelihood (REML) to estimate heterogeneity (Viechtbauer, 2005). To test for publication bias, funnel plots were inspected visually and Egger's test was conducted to test for asymmetry (Egger, Smith, Schneider, & Minder, 1997). If the visual inspection of the funnel plots and Egger's test indicated publication bias, the trim and fill method was used to investigate whether publication bias may have had an impact on the meta-analytic estimate (Duval & Tweedie, 2000a, 2000b). In absence of normally distributed effect sizes, the trim-and-fill algorithm adds 'missing' effects and computes a new meta-analysis in absence of publication bias.

1.3.6. Additional analyses

Questionnaires assessing counterfactual thinking (CFT) differed with respect to whether items referred specifically to traumatic events or assessed the tendency to engage in CFT in general. We will refer to the first category of studies as *CFT specific* and to the latter as *CFT general*. To test whether correlations between different CFT-constructs (i.e. CFT specific vs. CFT general vs. thoughts of regret vs. thoughts of undoing vs. 'what if'-thoughts vs. wishful thinking) and PTSD symptom severity differed in magnitude, a subgroup analysis was conducted. Also, a subgroup analysis was performed to analyse whether the use of validated vs. unvalidated measures of counterfactual comparative thinking was associated with differences in reported effect sizes. Moreover, study quality was analysed in a meta-regression to assess whether differences in methodological quality were associated with different magnitudes of association. Lastly, an additional analysis without two outlier-studies was conducted.

2. Results

2.1. Study selection

The literature search yielded 533 hits. Through screening of reference sections, we identified an additional six potentially eligible studies. We carefully screened titles and abstracts and identified 57 publications for full-text assessment. Of those, eight publications were excluded because they failed to meet eligibility criteria (i.e. irrelevant topic). Contractor, Weiss, Dranger, Ruggiero, and Armour (2017) and Erwin et al. (2018) reported data from the same study and we used the data reported in Erwin et al. We were not able to review full texts of seven PhD dissertations and two articles in Polish journals

(Bokszczanin, 2003; Bokszczanin & Kaniasty, 2002) as we were not able to retrieve the respective full texts. Another five journal articles failed to report the required data. We reached to all corresponding authors and we received required data from Patanwala et al. (2017) and Roley et al. (2015). The remaining three publications (Ellens et al., 2017; Korenromp, Page-Christiaens, van den Bout, Mulder, & Visser, 2009; Rouhani et al., 2016) could not be included due to missing replies. As such, a total of 36 eligible publications were included in the narrative review and 24 samples from 21 publications in the meta-analysis (see Figure 2).

2.2. Study characteristics

An overview of study characteristics and main findings is provided in Table 1. Publications on social ($k = 5$) or temporal comparative thinking ($k = 2$) were too heterogeneous and too few to warrant a meta-analytic review. However, a substantial amount of publications dealt with counterfactual comparative thinking ($k = 31$) warranting a meta-analysis on this issue. Two publications assessed more than one kind of comparative thinking (i.e. Boals & Schuettler, 2011; Brown et al., 2011).

2.2.1. Risk of bias within studies

Overall study quality was moderate, with an unweighted mean quality score of 4.08 (i.e. out of 10) across studies and a range from 2 to 7. The vast majority of eligible publication ($k = 32$) either reported on studies in samples with less than 50% of participants meeting diagnostic criteria for PTSD or did not report diagnostic rates altogether. Moreover, most publications ($k = 21$) reported that PTSD diagnosis was assessed with a self-report instrument. While only few ($k = 5$) relied on a psychiatric interview. In line with the inclusion criteria, all publications reported the assessment of PTSD symptom severity with a validated instrument. The majority of publications ($k = 22$) reported that comparative thinking was assessed with a validated instrument. The remaining 14 did not use a validated instrument to assess comparative thinking (e.g. self-constructed items). Finally, the majority of studies included ambiguous comparative thinking measures (i.e. not clearly differentiating comparison directions). Data for both upward and downward direction were reported in 11 publications only. Quality ratings can be found in Table A3 in the Appendix.

2.2.2. Results of individual studies on counterfactual comparative thinking

The majority of publications identified through literature search dealt with counterfactual comparative thinking. However, studies varied widely in their operationalization of counterfactual comparative thinking. Most research used the term *counterfactual*

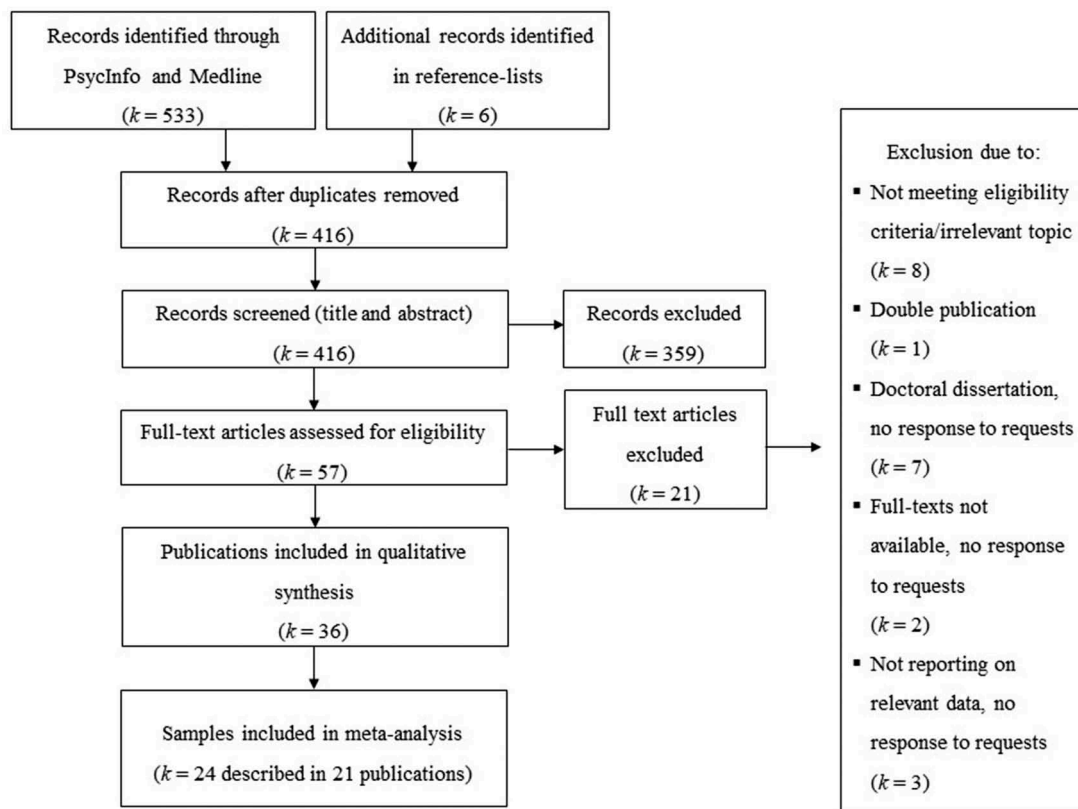


Figure 2. PRISMA flow chart depicting study synthesis.

thinking (CFT). Hence, we will use this term as an umbrella-term for the various terms that have been used to describe counterfactual comparative thinking constructs. A commonly chosen method was to ask participants how frequently they experienced or engaged in CFT. All but one study (Lee et al., 2018) found a positive relationship between frequency of CFT and PTSD symptomatology/diagnosis (more details in the meta-analytic results below).

Several studies assessed the direction of the first or most predominant CFT that came to mind using a thought listing task (Bhushan & Kumar, 2012; Blix et al., 2016; Dalgleish, 2004). In a study with 20 tsunami relief volunteers, 60% of respondents reported upward CFT first whereas the remaining 40% reported downward CFT first (Bhushan & Kumar, 2012). However, no data on the relationship between direction of CFT and number of PTSD symptoms. In contrast, Blix et al. (2016) found a predominance of downward CFT in a study with survivors of a terror attack. In their study, 90% of both directly and indirectly exposed individuals reported a downward counterfactual first whilst the remaining 10% reported an upward counterfactual first. Again, no data on the relationship between direction of CFT and PTSD symptomatology was reported. Dalgleish (2004) additionally coded the CFT for reference (i.e. self- vs. non-self-referent CFT) and found that trauma survivors predominantly reported

self-referent CFT (79%), upward CFT (87%) and self-referent upward CFT (68%). Furthermore, they found that CFT pattern was independent of level of PTSD symptomatology/PTSD diagnosis. Blix et al. (2016) also assessed intrusiveness of CFT and reported that intrusiveness of counterfactuals significantly predicted PTSD symptoms. Similarly, Blix et al. (2018) found that vividness of CFT served as a predictor of levels of PTSD symptoms. In another study, Miller et al. (2010) asked sexually assaulted women to describe the sexual assault and the impact it had on their lives and afterwards coded the number of counterfactual-preventability cognitions mentioned by the interviewees. However, the correlation between counterfactual-preventability cognitions and PTSD symptoms did not reach significance.

El Leithy et al. (2006) assessed CFT frequency with a thought listing task, as well as counterfactual fluency, defined as the availability of counterfactual thoughts. Participants were asked to report all counterfactual thoughts they had had about the trauma within a 60 s-time frame. Controlling for individual differences in verbal fluency, the authors found no significant relationship between general counterfactual fluency and posttraumatic symptoms nor between upward or downward counterfactual fluency and posttraumatic symptoms. Counterfactuals listed in the fluency task were also coded for reference (i.e. self-referent vs. other-referent), but again no significant relationship was found.

Table 1. Characteristics and main findings of included publications.

Author(s)	N	PTSD measure	Comparative thinking measure	Sample type	Age (M, SD)	Sex (% female)	PTSD diagnosis (% of whole sample)	Study design	Main findings
Counterfactual comparative thinking									
Counterfactual thinking (CFT)									
Bárliba and Dafinoiu (2015)	300	MCMII-III	CTNES	Clinical (mixed)	42.7 (12.7)	57.3	N.A.	Cross-sectional	In a multiple regression analysis PTSD diagnosis was a significant predictor for downward CFT scores on the CTNES, but not for upward CFT.
Bhushan and Kumar (2012)	20	IES	Thought listing task	High-risk group (i.e. tsunami relief volunteers)	31.6 (6.4)	100	N.A.	Cross-sectional	60% of participants reported an upward CFT first in a thought listing task, while 40% reported a downward CFT first. CFT frequency and PCL-5 scores were significantly related.
Blix et al. (2016), directly exposed sample	50	PCL-5	Thought listing task (direction), 2 items from CTNES (frequency)	Traumatized sample (i.e. directly exposed to Oslo Bombing 2011)	50.8 (9.6)	76	N.A.	Cross-sectional	The vast majority of traumatized participants reported a downward CFT first in a CFT listing task (i.e. 90%). Higher frequency of both upward and downward CFT was associated with higher PCL-5 scores.
Blix et al. (2016), indirectly exposed sample	50	PCL-5	2 items from CTNES (frequency), self-constructed scale for intrusiveness ratings of CFT (intrusiveness)	Traumatized sample (i.e. indirectly exposed to Oslo Bombing 2011)	52.9 (10.9)	76	N.A.	Cross-Sectional	Frequency of downward CFT is higher compared to frequency of upward CFT. Intrusiveness of CFT is highly correlated with PCL-5 scores.
Blix, Kantén, Birkeland, and Thoresen (2018)	185	PCL-5	Self-constructed scale for CFT (frequency), thought listing task for vividness ratings of CFT (vividness)	Traumatized sample (i.e. exposed to fire on a ferry)	55.4 (14.5)	50.8	17.3	Cross-sectional	Higher frequencies of both upward and downward CFT were associated with higher PCL-5 scores. Higher scores of vividness of CFT were associated with higher PCL-5 scores.
Claycomb et al. (2015)	304	PSS	RTSQ-CFT subscale	Traumatized sample (mixed)	42.6 (11.7)	64.1	38.2	Cross-sectional	RTSQ-CFT scores were positively associated with scores on all subscales of the PSS (i.e. re-experiencing, dysphoria, avoidance, hyperarousal).
Dalgleish (2004), study 1	37	IES	Thought listing task	Traumatized sample (mixed)	47.8 (12.2)	59.5	N.A.	Cross-sectional	The high-IES-score group did not differ from the low-IES-score group with respect to the direction or reference of the first mentioned CFT.
Dalgleish (2004), study 2	36	IES	Thought listing task	Traumatized sample (mixed)	39.5 (16.0)	41.7	47.2	Cross-sectional	PTSD group did not differ from non-PTSD group with respect to CFT direction or reference.
El Leithy et al. (2006)	46	IES-R	Thought listing task with frequency rating	Traumatized sample (i.e. physical assault)	N.A.	19.6	37.0	Cross-sectional	Frequency of CFT was positively associated with PTSD scores. Fluency/availability of CFT was not associated with IES-R score.
Erwin et al. (2018)	119	PCL-5	RTSQ-CFT subscale	Traumatized sample (mixed)	35.7 (11.8)	68.1	32.8	Cross-sectional	RTSQ-CFT scores were positively associated with PCL-5 scores.
Gilbar, Plivazky, and Gil (2010)	176	PSS-SR	Self-constructed measure	Traumatized sample (i.e. victims of terrorist attacks)	46.3 (13.7)	49.4	54.6	Cross-sectional	PTSD diagnosis was correlated with higher frequency of upward and downward CFT.
Kelley et al. (2019)	283	PCL-5	RTSQ-CFT subscale	High-risk group (i.e. military personnel)	36.6	7.1	N.A.	Cross-sectional	RTSQ-CFT scores were positively associated with PCL-5 scores.
Miller, Handley, Markman, and Miller (2010)	149	IES-R	Number of counterfactual-preventability cognitions	Traumatized sample (sexual assault)	N.A.	100	N.A.	Cross-sectional	Number of counterfactual-preventability statements in interview were not correlated with IES-R scores.
Mitchell, Contractor, Dranger, and Shea (2016)	51	PCL-5	RTSQ-CFT subscale	Traumatized sample (mixed)	34.7 (11.8)	72.5	39.0	Cross-sectional	RTSQ-CFT scores were positively correlated with PCL-5 scores.

(Continued)

Table 1. (Continued).

Author(s)	N	PTSD measure	Comparative thinking measure	Sample type	Age (M, SD)	Sex (% female)	PTSD diagnosis (% of whole sample)	Study design	Main findings
Roley et al. (2015)	45	PCL-5	RTSQ-CFT subscale	Traumatized sample (mixed)	34.1 (11.5)	76.0	53.0	Cross-sectional	RTSQ-CFT scores were positively correlated with PCL-5 scores.
Wishful thinking Brauchle (2005)	74	PDS	CSQ-wishful thinking subscale	High-risk group (i.e. police officers)	39.2 (9.5)	6.8	8.1	Cross-sectional and longitudinal	Wishful thinking scores at t0 were positively correlated with PDS scores at t0 as well as t1.
Clohesy and Ehlers (1999)	56	PSS	CSQ-wishful thinking subscale	High-risk group (i.e. ambulance service workers)	35.0 (8.7)	23.0	21.0	Cross-sectional	Wishful thinking scores were positively correlated with PSS scores.
Dirkzwager, Bramsen, and van der Ploeg (2003) ^a	291	SRIP	WCQ-Wishful thinking subscale	High-risk group (i.e. peacekeeping mission)	N.A.	N.A.	N.A.	Cross-sectional and longitudinal	Wishful thinking scores at t0 were positively correlated with SRIP scores at t0 and t1.
Dirkzwager et al. (2003) ^b	471	SRIP	WCQ-Wishful thinking subscale	High-risk group (i.e. peacekeeping mission)	N.A.	N.A.	N.A.	Cross-sectional and longitudinal	Wishful thinking scores at t0 were positively correlated with SRIP scores at t0 and t1.
Dougall et al. (2001)	81	SCID	WCQ-Wishful thinking subscale	Traumatized sample (i.e. survivors of motor vehicle accidents)	35.0 (13.0)	46.1	61.0	Longitudinal	Wishful thinking at t0 was positively correlated with PTSD diagnosis at t1 and t2.
Fairbank, Hansen, and Fitterling (1991)	30	MMPI	WOC-R-Wishful thinking subscale	Mixed sample (i.e. war prisoners with and without PTSD, healthy control group)	64.4 (4.4)	0.0	33.3	Cross-sectional	War prisoners with PTSD engaged in wishful thinking more frequently than war prisoners without PTSD and a healthy control group.
Lee, Park, and Sim (2018)	212	IES-R	WCCL-Wishful thinking subscale	High-risk group (i.e. firefighters)	41.4 (8.3)	5.7	N.A.	Cross-sectional	Wishful thinking in firefighters was not significantly correlated with IES-R scores.
Marsac, Donlon, Winston, and Kassam-Adams (2011)	71	CPSS	KidCope-Wishful thinking subscale	Traumatized sample (i.e. physical injury)	12.1 (2.7)	30.0	N.A.	Cross-sectional	Three months post-injury, all children with PTSD symptoms and most children without PTSD symptoms (i.e. 98%) reported to use wishful thinking. Wishful thinking was a common coping strategy in children after physical injury.
Pole, Best, Metzler, and Marmar (2005)	666	MS-CV	WCCL-Wishful thinking subscale	High-risk group (i.e. police officers)	37.2 (6.8)	21.0	N.A.	Cross-sectional	Wishful thinking was positively associated with MS-CV scores.
Tsay, Halstead, and McCrone (2001)	152	IES	WCS-Wishful thinking subscale	Traumatized sample (i.e. hospitalized for 5–7 days after traumatic injury)	34.7 (11.8)	31.6	N.A.	Cross-sectional	Wishful thinking and avoidance coping significantly predicted IES scores.
Valentine, Foa, Riggs, and Gershuny (1996)	133	PSS	WOC-Abbr.-Wishful thinking subscale	Traumatized sample (i.e. victims of physical/sexual assault)	30.4 (9.6)	100	35.0	Cross-sectional	Wishful thinking was positively correlated with PSS scores.
Ye, Chen, and Lin (2018)	140	IES	WCS-Wishful thinking subscale	Traumatized sample (i.e. HIV-infection)	26.6 (3.3)	0.0	N.A.	Cross-sectional	Wishful thinking was positively correlated with IES scores.
Thoughts of undoing Dunmore, Clark, and Ehlers (1999)	88	PSS-SR	Self-constructed scale	Traumatized sample (i.e. victims of physical/sexual assault)	39.2 (15.9)	47.8	69.6	Cross-sectional	The PTSD group engaged in undoing-thoughts significantly more often than the non-PTSD group.

(Continued)

Table 1. (Continued).

Author(s)	N	PTSD measure	Comparative thinking measure	Sample type	Age (M, SD)	Sex (% female)	PTSD diagnosis (% of whole sample)	Study design	Main findings
Dunmore, Clark, and Ehlers (2001)	57	PSS-SR	Self-constructed scale	Traumatized sample (i.e. victims of physical/sexual assault)	35.4 (12.8)	54.0	N.A.	Cross-sectional and Longitudinal	Undoing-thoughts (t0) were positively correlated with PSS-SR scores at t0 and t1 (i.e. 6-month follow-up), but not at t2 (i.e. 9-month follow-up).
Thoughts of regret									
Boals and Schuettler (2011)	929	PCL-5	CPOTS (regrets, downward comparison)	63% of undergraduate sample traumatized (i.e. mixed traumas)	20.1 (3.6)	64.9	N.A.	Cross-sectional	Regret was significantly correlated with PCL-5 scores.
Mizota, Ozawa, Yamazaki, and Inoue (2006)	282	IES-R	Sense of guilt and regret (items derived from qualitative interviews)	Traumatized sample (i.e. bereaved)	58.2 (12.0)	64.0	59.4	Cross-sectional	Sense of guilt and regret were positively correlated with IES-R scores.
Patanwala et al. (2017)	283	PC-PTSD	Regret	Mixed sample (i.e. homeless population)	> 50 years	24.4	N.A.	Cross-sectional	Regret was positively associated with PC-PTSD scores.
'What if' - thoughts									
Michael, Halligan, Clark, and Ehlers (2007), study 2	81	PDS	Rumination Interview	Traumatized sample (i.e. victims of physical/sexual assault)	32.3 (11.9)	39.5	40	Cross-sectional	'Why'- and 'what-if'-thoughts were positively correlated with PDS scores.
Michael et al. (2007), study 1	73	PDS	Rumination Interview	Traumatized sample (i.e. victims of physical/sexual assault)	40.4 (14.8)	45.2	37	Cross-sectional and longitudinal	'Why'- and 'what-if'-thoughts were positively correlated with PDS scores at t0 and t1.
Birrer and Michael (2011)	65	PDS	Rumination Interview	Mixed clinical sample (i.e. PTSD group, Depression + trauma group, Depression - trauma group)	44.8 (13.6)	N.A.	40.0	Cross-sectional	No significant association between 'why' and 'what-if'-thoughts and PDS scores was found.
Social comparative thinking									
Boals and Schuettler (2011)	929	PCL-5	CPOTS-downward comparison subscale	63% of undergraduate sample traumatized (i.e. mixed traumas)	20.1 (3.6)	64.9	N.A.	Cross-sectional	Downward comparisons were not correlated with PCL-5 scores.
Brown, Buckner, and Hirst (2011)	30	CAPS	Modified temporal appraisal measure (with the instruction to rate others)	Traumatized sample (i.e. combat exposure)	30.5 (4.6)	0.0	50.0	Cross-sectional	Veterans with PTSD rated others as functioning better in comparison to themselves while veterans without PTSD rated others as functioning worse in comparison to themselves.
Hooberman, Rosenfeld, Rasmussen, and Keller (2010)	75	HTQ	SES	Traumatized sample (mixed)	33.0 (8.5)	41.3	40.0	Cross-sectional	Downward social comparative thinking was positively associated with HTQ scores whereas upward social comparative thinking was not.
Morris et al. (2012)	51	IES-R	Identification-Contrast Scale	Traumatized sample (i.e. breast cancer survivors)	49.8 (7.0)	100	7.8	Cross-sectional	No significant correlations between upward contrast, downward/upward identification and IES-R scores were found.
Troop and Hiskey (2013)	271	PDS	SCRS	Traumatized sample (mixed)	31.5 (11.4)	75.3	67.0	Cross-sectional	The PTSD group rated themselves less favourable in relation to others compared to the non-PTSD group.
Temporal comparative thinking									
Roth, Steffens, Morina, and Stangier (2011)	58	SCID	IAT (present-self/prior self - positive/negative)	Traumatized sample (mixed)	39.8 (12.2)	63.8	31.0	Cross-sectional	IAT effect (difference between prior self/positive vs. present self/positive) was smaller in PTSD group compared to past PTSD and non-PTSD group. PTSD group reacted slower in both conditions compared to non-PTSD group.

(Continued)

Table 1. (Continued).

Author(s)	N	PTSD measure	Comparative thinking measure	Sample type	Age (M, SD)	Sex (% female)	PTSD diagnosis (% of whole sample)	Study design	Main findings
Brown et al. (2011)	30	CAPS	Modified temporal appraisal measure	Traumatized sample (i.e. combat exposure)	30.5 (4.6)	0.0	50.0	Cross-sectional	Veterans with PTSD rated their past selves more favourably than their current and future selves whilst veterans without PTSD rated their past selves less favourable than their present and future selves.

References can be found in the Appendix. NA = not applicable/not reported, PTSD = posttraumatic stress disorder; MCMII-III = Millon Clinical Multiaxial Inventory-III, IES/IES-R = Impact of Event Scale (Revised), PCL-5 = PTSD Checklist for DSM-5, PSS/PSS-SR = Posttraumatic Stress Disorder Symptom Scale (Self-Report), PDS = Posttraumatic Diagnostic Scale, SRIP = Self-Rating Inventory for PTSD, MMPI = Minnesota Multiphasic Personality Inventory (PTSD scale), CPSS = Child PTSD Symptom Scale, MS-CV = Mississippi Scale - Civilian Version, PC-PTSD = Primary Care PTSD, CAPS = Clinician-Administered PTSD Scale, HTQ = Harvard Trauma Questionnaire, SCID = Structured Clinical Interview for DSM; Measures of comparison/comparison-related construct: CTNES = Counterfactual Thinking for Negative Events Scale, RTSQ = Ruminative Thought Style Questionnaire, CSQ = Coping Strategies Questionnaire, WCQ = Ways of Coping Questionnaire, WOC-R = Ways of Coping Checklist-Revised, WCCL = Ways of Coping Checklist, WCS = Ways of Coping Scale, WOC-Abbr. = Ways of Coping Checklist - Abbreviated, CPOTS = Cognitive Processing of Trauma Scale, SES = Self-Evaluation Scale, SCRS = Social Comparison Rating Scale, IAT = Implicit Association Test.

2.2.3. Social comparative thinking

Five studies addressed the relationship between PTSD symptomatology and social comparative thinking. Each study utilized a different approach towards measuring social comparative thinking precluding a meta-analytic summary of results. In their study with trauma-exposed refugees, Hooberman et al. (2010) utilized a Self-Evaluation Scale (SES) that was originally developed to assess social comparative thinking in chronically ill patients (Wilson, Gil, & Raezer, 1997). The SES assesses social comparative thinking as an active coping strategy with items such as 'When experiencing (...) pain, I remind myself that there are people who are worse off than I am'. The authors found a significant positive correlation between downward comparative thinking items and PTSD symptom severity ($r = 0.29$), whilst upward social comparative thinking items were not significantly associated with PTSD symptom severity.

Morris et al. (2012) surveyed breast cancer survivors with the Identification-Contrast Scale before and after taking part in a peer support program. The Identification-Contrast Scale consists of four subscales: upward identification, upward contrast, downward identification, and downward contrast. Items tap into affective consequences of social comparative thinking (e.g. downward identification: 'When I see others who are doing worse, I fear that my future will be similar'). The authors hypothesized that cancer survivors would mainly identify with survivors who are doing better (i.e. upward identification) and contrast themselves against those who are doing worse (i.e. downward contrast). They found that pre-ride upward identification was significantly negatively correlated with post-ride distress, providing some support for a beneficial coping effect of upward social comparative thinking leading to identification.

Brown et al. (2011) and Troop et al. (2013) utilized social comparative thinking measures that do not distinguish between upward and downward comparison. Rather, participants were asked to evaluate themselves in comparison to others on different personality dimensions. Brown et al. (2011) asked a sample of combat-veterans to rate themselves as well as other veterans on 10 different dimensions on a 10-point scale (e.g. socially skilled, self-confident). They found that combat-veterans with PTSD rated others more favourably than themselves while combat-veterans without PTSD rated others less favourably than themselves. The authors also included a temporal-social comparative thinking (i.e. future selves). The same pattern emerged for self- and other-ratings referring to the future.

Troop et al. (2013) used the Social Comparison Rating Scale (Allan & Gilbert, 1995) in which participants are asked to rate themselves in comparison to

others on 11 items consisting of two contrary adjectives at either end of a 10-point scale (e.g. different-same, weaker-stronger). They found that traumatized participants with PTSD rated themselves significantly lower on the SCRS than the traumatized group without PTSD.

Boals and Schuettler (2011) applied the Cognitive Processing of Trauma Scale (CPOTS). The subscale *downward comparison* consists of three items: 1. 'Other people have had worse experiences than mine.'; 2. 'Even though my experience was difficult, I can think of ways that it could have been worse.'; 3. 'My situation is not so bad compared to other people's situation', with items 1 and 3 involving social comparative thinking. For this reason, we decided to report results related to the subscale downward comparison in this section. In a sample of undergraduate students, with 63% reporting at least one traumatic life experience (i.e. diverse trauma types), downward comparison was not significantly correlated with PTSD symptom score.

2.2.4. Temporal comparative thinking

Two studies dealt with aspects of temporal comparative thinking in PTSD. Brown et al. (2011) asked veterans to rate themselves on the temporal self-appraisal measure described above over three different time points: 'now and very recently' (i.e. current), 'way back before your military service' (i.e. past), and 'far into the future' (i.e. future). They found that veterans with PTSD rated their past selves more positive in comparison to their current and their future selves. In contrast, veterans without PTSD rated their future selves more positive than their current selves and their current selves more positive than their past selves. The study by Roth et al. (2011) was the only study included in this review applying an experimental design. The authors conducted an Implicit Association Test (IAT; Greenwald & Farnham, 2000) using stimuli representing the self (i.e. present-vs. past-self) and stimulus attributes (i.e. positive vs. negative). The authors found that participants without PTSD reacted faster both in the present-self-positive and the past-self-positive condition compared to participants with PTSD. Additionally, the PTSD group demonstrated a significantly smaller difference between the two IAT conditions than the non-PTSD group which was interpreted by the authors as a maladaptive missing increase in implicit self-esteem over time in individuals with PTSD.

2.2.5. Main analysis

The only construct with enough studies reporting the same kind of quantitative association with PTSD was frequency of CFT (see Table 2). In total, the relationship between PTSD symptomatology and CFT frequency was reported in 24 independent samples from 21 publications (see the corresponding forest plot in Figure 3). The overall effect size was $r = .46$, $p < .001$,

Table 2. Results from the subgroup analysis on various CFT-constructs.

CFT construct	<i>k</i>	<i>r</i>	<i>SE</i>	95% CI
CFT specific	4	.60*	.01	[.47; .71]
CFT general	5	.42*	.08	[.28; .54]
Thoughts of regret	3	.37*	.09	[.20; .52]
Thoughts of undoing	2	.43*	.14	[.19; .63]
'What if'- thoughts	2	.52*	.14	[.30; .69]
Wishful thinking	8	.46*	.06	[.36; .55]

* $p < .001$.

95% CI [.40; .52], indicating a medium to large correlation between PTSD symptomatology and CFT frequency (Cohen, 1988).

2.3. Risk of bias across studies

Heterogeneity was high, $\hat{\tau}^2 = 0.03$, $SE = .001$, 95% CI [0.01; 0.06]; $I^2 = 81.23\%$; $Q(23) = 126.70$, $p < .001$, supporting the use of random effects modelling (Higgins, Thompson, Deeks, & Altman, 2003).

2.3.1. Additional analyses

The mentioned four additional analyses were conducted. All CFT-constructs were significantly associated with PTSD symptom severity and effect sizes overlapped considerable (see Table 2). Accordingly, the subgroup analysis by CFT-construct yielded a non-significant result, $Q_M(5) = 6.20$, $p = .287$. Studies assessing CFT trauma-specifically yielded the largest association with PTSD symptomatology, whereas the correlation between thoughts of regret and PTSD symptomatology was the smallest.

To analyse whether the use of validated vs. unvalidated measures of counterfactual comparative thinking was associated with differences in reported effect sizes, we performed another subgroup analysis. This was found to be non-significant indicating that reported effect sizes did not differ significantly when studies with validated vs. unvalidated measures of counterfactual comparative thinking were compared, $Q_M(1) = 3.34$, $p = .07$. To analyse whether overall study quality had an influence on reported effect sizes, study quality was analysed as a potential moderator in a meta-regression. The corresponding scatter plot can be found in Figure 4. The omnibus test was significant, $Q_M(1) = 5.66$, $p < .05$, indicating that reported effect sizes differed across the range of study quality with higher quality scores being associated with higher magnitudes of effect. Study quality explained 24.90% of total heterogeneity. Residual heterogeneity remained significant, $Q_M(22) = 78.15$, $p < .001$.

Lastly, we conducted another meta-analysis excluding two studies that presented statistical outliers (i.e. Kelley et al., 2018; Lee et al., 2018). Outliers were defined as reporting effect sizes deviating >3.3

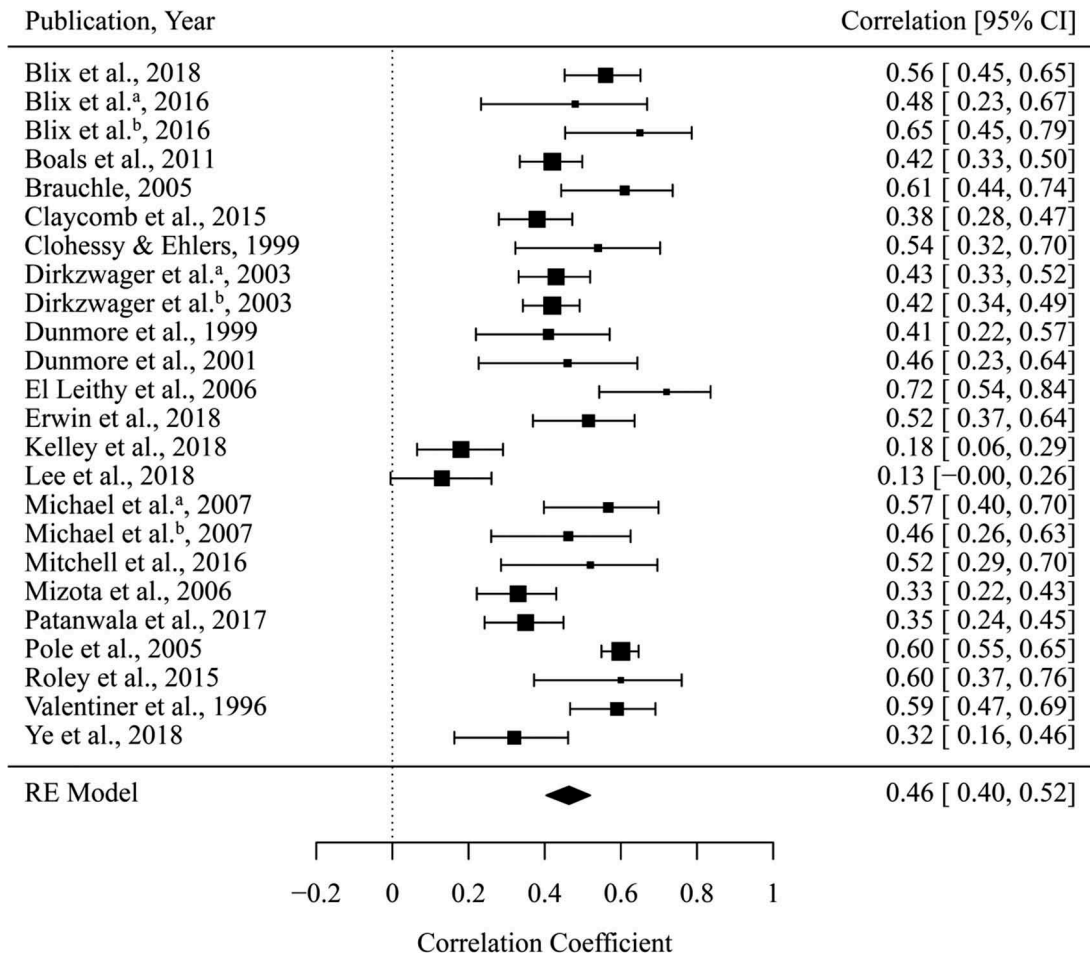


Figure 3. Forest plot depicting correlations between PTSD severity and various types of CFT.

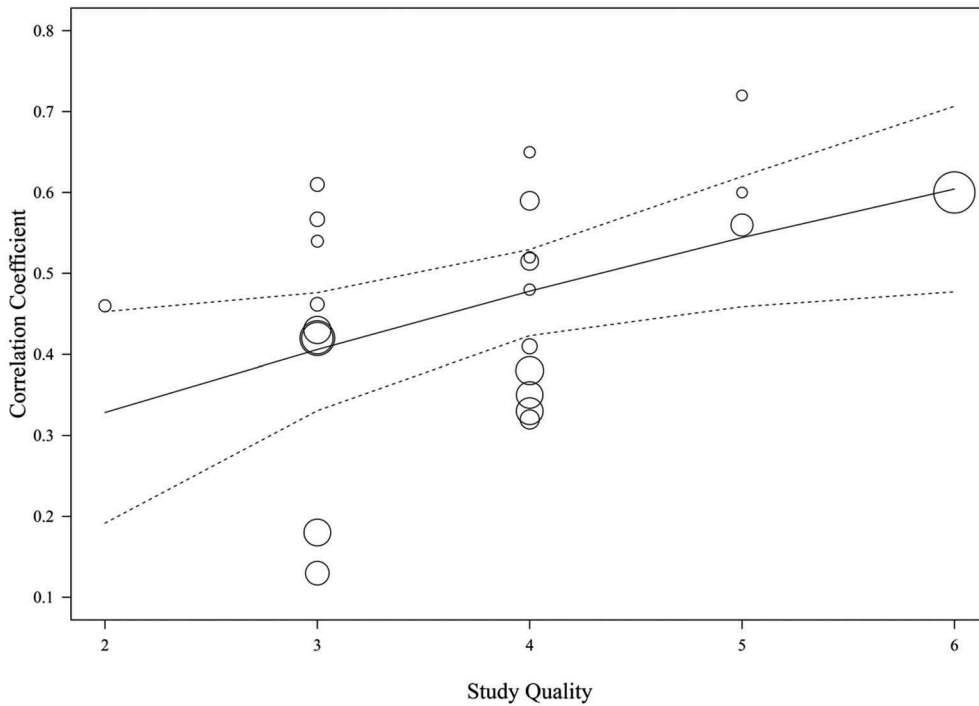


Figure 4. Scatter plot depicting the association between study quality and effect sizes.

SD from the mean (Hunter & Schmidt, 2004; Tabachnik & Fidell, 2013). When outlier studies

were excluded, random effect overall effect size increased to $r = .53$, $p < .001$, 95% CI [.47; .59],

indicating a large-sized correlation between PTSD symptomatology and CFT frequency. Heterogeneity remained high, $\hat{\tau}^2 = 0.01$, $SE = .00$, 95% CI [0.00; 0.03]; $I^2 = 68.43\%$; $Q(21) = 71.34$, $p < .001$, supporting the use of random effects modelling.

3. Discussion

Our systematic review demonstrates that there is a slim but promising and emerging research base on the role of social and temporal comparative thinking in PTSD. Since only five and two publications on social and temporal comparative thinking were found, respectively, we were not able to conduct a quantitative review. The scarcity of research on the relationship between PTSD and both social and temporal comparison is surprising in the light of the outlined theoretical notions and older empirical accounts indicating the relevance of such comparisons in the wake of threat and stress (e.g. Taylor & Lobel, 1989). However, the slim existing evidence base is in line with prominent models of comparative thinking such as the REM by indicating that PTSD is associated with distortions in all three comparison types. In terms of counterfactual comparative thinking, we were able to synthesize data from 24 samples in 21 publications on the correlational between PTSD symptom severity and frequency of counterfactual comparative thinking.

3.1. Social comparative thinking

The five publications on social comparison used heterogeneous instruments precluding a meta-analysis. Hooberman et al. (2010) demonstrated that downward comparisons were positively correlated with PTSD symptoms in a sample of torture survivors. Brown et al. (2011) found that veterans with PTSD rated themselves less favourable than other veterans at present and in the future whereas veterans without PTSD rated themselves more favourable than other veterans at present and in the future. Troop and Hiskey (2013) reported that patients with PTSD rated themselves lower in comparison to others than traumatized individuals without PTSD. Only Morris et al. (2012) found no significant associations between any social comparison measure and PTSD symptomatology in women diagnosed with breast cancer. It remains speculative whether the trauma of receiving a breast cancer diagnosis may impact social cognition differently than do other types of trauma. Moreover, the utilized social comparison measure may be criticized. Wood (1996) argued that social comparisons should not be measured in combination with their affective consequences. The Identification-Contrast Scale used by Morris et al. (2012), however, taps into both (e.g. 'When I see others who are doing

worse, I fear that my future will be similar'). Overall, the slim available evidence base on social comparison in PTSD indicates that individuals with greater PTSD symptom severity seem to engage more frequently in social comparisons.

3.2. Temporal comparative thinking

The findings from Brown et al. (2011) are in line with temporal self-appraisal theory, in which Ross and Wilson (2000) suggested that people actively construct temporal comparison standards that serve self-enhancement motives (see also McFarland & Alvaro, 2000). The authors demonstrated that veterans without PTSD showed the predicted perception of self-improvement over time (i.e. ratings increased from past over current to future selves) whereas veterans with PTSD showed a differential pattern by rating their past selves the most positive and indicating no improvement from present to future. Similarly, Roth et al. (2011) conclude that their IAT-results are in line with cognitive models, which highlight that negative self-appraisals in the aftermath of trauma predict the development and maintenance of PTSD. These two publications provide preliminary evidence that PTSD symptomatology might be associated with distorted patterns of temporal self-appraisal. The reported findings are also in line with other results indicating that traumatized individuals show high levels of temporal disintegration (Holman & Silver, 1998).

3.3. Counterfactual comparative thinking

3.3.1. Frequency of CFT

The available literature suggests a medium to large correlation between PTSD symptomatology and CFT frequency. While used constructs varied considerably, it appeared that the more specific the CFT measure was tailored to traumatic experiences and the higher the quality of the study, the higher the reported correlation between PTSD symptom severity and CFT frequency. Findings on the CFT-PTSD link complement the meta-analysis conducted by Broomhall et al. (2017) on the link between CFT and depression, supporting the idea that an excess of CFT seems to be associated with psychopathology.

3.3.2. Direction of CFT

Several authors have suggested that people should be more likely to engage in upward CFT as opposed to downward CFT after experiencing negative events (Haynes et al., 2007; Kahneman & Miller, 1986; Roese, 1994, 1997; Roese & Olson, 1997). Most publications investigating this hypothesis reported results confirming the hypothesis with two publications indicating that upward CFT after trauma seems to be more easily accessible than downward CFT

(Bhushan & Kumar, 2012; Dalgleish, 2004) and several publications indicating higher frequencies of upward CFT compared to downward CFT (e.g. Blix et al., 2018). However, one publication indicated the opposite pattern with slightly less frequent and less easily accessible upward CFT when compared to downward CFT (Blix et al., 2016). The authors investigated CFT in individuals directly or indirectly exposed to the 2011 Oslo bombing and argued that downward CFT (e.g. 'It could have been me who was killed ... ') may be particularly salient and easily accessible after mass trauma since the adverse outcome actually happened to others. Predominance and accessibility of CFT direction may differ by trauma type (e.g. interpersonal vs. interpersonal, individual vs. collective trauma, etc.), exposure type (e.g. direct exposure vs. indirect exposure/observer) and so forth with too few publications to warrant meta-analytic review. Moreover, the utility and validity of focusing on the first mentioned CFT remains to be evaluated. It is unclear whether the first mentioned CFT is, in fact, the most important and/or the most frequent one particularly in the light of potential implicit cognitive avoidance strategies as well as social desirability in a research context.

3.3.3. Vividness of CFT

A slim evidence base exists indicating that CFT vividness and PTSD symptomatology seem to be positively related (Blix et al., 2016, 2018).

3.4. Strengths

This is the first systematic review on the relationship between PTSD symptomatology and social, temporal and counterfactual comparative thinking. PTSD is a common mental disorder causing chronic severe functional impairment if left untreated. A more sophisticated understanding of the cognitive mechanisms involved in the aetiology and maintenance of PTSD may ultimately help improving clinical intervention.

3.5. Limitations

3.5.1. Validity of measures

Most publications included in this article used self-reports to assess comparative thinking. Wood (1996) highlighted potential flaws of self-report measures. Self-reports rest on the assumption that respondents are fully aware of their cognitions and willing to report these. Many comparative processes, however, may function on an unconscious or subconscious level and social desirability may further undermine the validity of responses. Furthermore, most self-reports assess retrospectively and are, therefore, prone to memory biases. Hence, future research should include additional methodological approaches

to assess comparative thinking such as implicit measures and ecological momentary assessments to improve internal and external validity of measures. Moreover, we would like to encourage the development of more valid trauma-tailored comparison measures that take both direction (i.e. upward vs. downward) and evaluation (i.e. contrast vs. assimilation) into account. Many of the chosen measures do not tease apart direction and/or evaluation potentially leading to Simpson's paradox (i.e. missing significant associations due to too much lumping).

3.5.2. Search strategy

We only searched for two databases. We cannot exclude the possibility that we have missed relevant empirical work. However, by screening reference lists of all eligible studies as well as related systematic reviews (i.e. Byrne, 2016; Epstude & Roese, 2008; Kahneman & Miller, 1986; Kangas et al., 2002; Markman & McMullen, 2003; Mussweiler, 2003; Roese et al., 2017; Taylor & Lobel, 1989) and meta-analyses (i.e. Broomhall et al., 2017; Gerber et al., 2018) we tried to maximize our outreach.

3.5.3. General validity of results

The meta-analytic results may be biased due to publication bias and moderate study quality. The results from the systematic review are to be scrutinized with due caution since the available evidence base is too thin and methodologically not sound enough to draw firm conclusions. Our choice of quality criteria should be critically scrutinized. We gave studies higher quality scores if the diagnosis of PTSD was clinician-rated, symptom severity was measured with a validated measure and the vast majority of participants (i.e. >80%) fulfilled diagnostic criteria. This choice was based on the clinical focus of the research question, i.e. the relation between PTSD symptomatology and comparative thinking. Furthermore, we gave studies a higher quality score if the comparison measure has been validated and when the utilized comparison measure took direction (i.e. upward vs. downward) into account. The latter was based on research findings indicating that different directions of comparisons may yield different association with symptomatology (e.g. Broomhall et al., 2017). Accordingly, our quality criteria are specifically tailored towards the current research question and might need to be adjusted for future use.

3.6. Empirical implications

More research on the relationship between PTSD and comparative thinking is needed in clinical samples to draw more specific conclusions. Since the vast majority of empirical work in this line of research has been conducted cross-sectionally, it remains speculative

which exact role comparative thinking may play in the aetiology and/or maintenance of PTSD. We encourage longitudinal and experimental studies and the use of validated implicit as well as explicit measures of comparative thinking to get a more sophisticated understanding of the interrelation and dynamics between PTSD and comparative thinking. While the studies on CFT that we included in our meta-analysis measured frequency of CFT, some of the studies on social comparison and temporal comparison discussed in our narrative review measured self-evaluation rather than frequency. Frequency and self-evaluation can be related but should not be confused with one another. Our results suggest that both might be relevant in the aftermaths of trauma and should therefore be addressed separately in future research.

Moreover, we would like to encourage more research that targets trauma-tailored counterfactual comparative thinking with a reference to a present attribute. All of the included studies on CFT focused on counterfactuals with a reference to the past only. An example for such a focus would be the counterfactual of an individual who has been assaulted: 'If only I had screamed, somebody would have helped me'. However, this individual might further think that if only she had screamed and somebody had helped her, she would now be a healthier or braver person than she really is. In this instance, this person is conducting a counterfactual comparison of her current well-being with the well-being she might have had if she had screamed. Accordingly, future research on self-perception should also examine the extent to which traumatized individuals compare their current self-perceptions with counterfactual ones.

3.7. Clinical implications

If empirical research accumulates and corroborates the apparent link between PTSD symptomatology and distortions in social, temporal and counterfactual comparative thinking, clinical implications may follow. The slim available evidence indicates that comparative thinking might indeed be a fruitful avenue in this regard.

4. Conclusion

Both the systematic review and the meta-analysis provide preliminary evidence that PTSD symptomatology is associated with distortions in social and temporal comparative thinking as well as frequent and vivid counterfactual comparative thinking. However, most of the included research was conducted in sub-clinical samples and is of cross-sectional nature precluding conclusions concerning causality. More clinical longitudinal research utilizing validated comparison measures (i.e. trauma-tailored,

implicit as well as explicit, differentiating direction as well as evaluation of comparison) is needed to acquire a more sophisticated understanding of the role of social, temporal and counterfactual comparative thinking in the aetiology and maintenance of PTSD. This may ultimately inform treatment approaches for PTSD.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sector. The authors report no financial relationships with commercial interests.

Statement of ethics

Not applicable.

Author contributions

THH and NM designed the study. THH and IHF conducted the literature search and quality coding. THH, NM and IHF conducted the analyses and wrote the manuscript.

ORCID

Thole H. Hoppen  <http://orcid.org/0000-0002-6050-8696>
Nexhmedin Morina  <http://orcid.org/0000-0002-2331-9140>

References

- Albert, S. (1977). Temporal comparison theory. *Psychological Review*, 84(6), 485–503.
- Allan, S., & Gilbert, P. (1995). A social comparison scale: Psychometric properties and relationship to psychopathology. *Personality and Individual Differences*, 19(3), 293–299.
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed.). Washington, DC: American Psychiatric Publishing.
- Bokszczanin, A. (2003). The role of coping strategies and social support in adolescent's well-being after a flood. *Polish Psychological Bulletin*, 34(2), 67–72.
- Bokszczanin, A., & Kaniasty, K. (2002). The impact of 1977 flood on children and adolescent symptoms of PTSD, depression and loneliness: The role of coping strategies. *Studia Psychologiczne*, 40(2), 21–39.
- Brewin, C. R., Dalgleish, T., & Joseph, S. (1996). A dual representation theory of posttraumatic stress disorder. *Psychological Review*, 103(4), 670–686.
- Broomhall, A. G., Phillips, W. J., Hine, D. W., & Loi, N. M. (2017). Upward counterfactual thinking and depression: A meta-analysis. *Clinical Psychology Review*, 55, 56–73.
- Butzer, B., & Kuiper, N. A. (2006). Relationships between the frequency of social comparisons and self-concept clarity, intolerance of uncertainty, anxiety, and

- depression. *Personality and Individual Differences*, 41(1), 167–176.
- Buunk, B. P., & Gibbons, F. X. (2005). Social comparison orientation: A new perspective on those who do and those who don't compare with others. In S. Guimond & S. Guimond (Eds.), *Social comparison and social psychology* (pp. 15–32). Cambridge: Cambridge University Press.
- Byrne, R. M. (2016). Counterfactual thought. *Annual Review of Psychology*, 67, 135–157.
- Cicchetti, D. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. *Psychological Assessment*, 6(4), 284–290.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Contractor, A. A., Weiss, N. H., Dranger, P., Ruggero, C., & Armour, C. (2017). PTSD's risky behavior criterion: Relation with DSM-5 PTSD symptom clusters and psychopathology. *Psychiatry Research*, 252, 215–222.
- Dunning, D., & Madey, S. F. (1995). Comparison processes in counterfactual thought. In N. J. Roese & J. M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking* (pp. 103–131). Mahwah, NJ: Lawrence Erlbaum Associates.
- Duval, S., & Tweedie, R. (2000a). A nonparametric “Trim and fill” method of accounting for publication bias in meta-analysis. *Journal of the American Statistical Association*, 95(449), 89–98.
- Duval, S., & Tweedie, R. (2000b). Trim and fill: A simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics*, 56(2), 455–463.
- Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *British Medical Journal*, 315, 629–634.
- Ehlers, A., & Clark, D. M. (2000). A cognitive model of posttraumatic stress disorder. *Behaviour Research and Therapy*, 38(4), 319–345.
- Ellens, R. E. H., Bakula, D. M., Mullins, A. J., Reyes, K. J. S., Austin, P., Baskin, L., ... Galan, D. (2017). Psychological adjustment of parents of children born with atypical genitalia 1 year after genitoplasty. *The Journal of Urology*, 198(4), 914–920.
- Epstude, K., & Roese, N. J. (2008). The functional theory of counterfactual thinking. *Personality and Social Psychology Review*, 12(2), 168–192.
- Festinger, L. (1954). A theory of social comparison processes. *Human Relations*, 7(2), 117–140.
- Gerber, J. P., Wheeler, L., & Suls, J. (2018). A social comparison theory meta-analysis 60+ years on. *Psychological Bulletin*, 144(2), 177–197.
- Gibbons, F. X., & Buunk, B. P. (1999). Individual differences in social comparison: Development of a scale of social comparison orientation. *Journal of Personality and Social Psychology*, 76(1), 129–142.
- Greenwald, A. G., & Farnham, S. D. (2000). Using the implicit association test to measure self-esteem and self-concept. *Journal of Personality and Social Psychology*, 79(6), 1022–1038.
- Haynes, G. A., Sorrentino, R. M., Olson, J. M., Szeto, A. C., Wirkki, J. S., & O'Connor, M. C. (2007). The effects of temporal framing on counterfactual thinking and self-appraisal: An individual differences perspective. *Social Cognition*, 25(3), 339–366.
- Higgins, J. P., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *British Medical Journal*, 327, 557–560.
- Holman, E. A., & Silver, R. C. (1998). Getting “stuck” in the past: Temporal orientation and coping with trauma. *Journal of Personality and Social Psychology*, 74(5), 1146–1163.
- Hunter, J., & Schmidt, F. (2004). *Methods of meta-analysis: Correcting error and bias in research findings*. London: Sage Publications.
- Kahneman, D., & Miller, D. T. (1986). Norm theory: Comparing reality to its alternatives. *Psychological Review*, 93(2), 136–153.
- Kangas, M., Henry, J. L., & Bryant, R. A. (2002). Posttraumatic stress disorder following cancer: A conceptual and empirical review. *Clinical Psychology Review*, 22, 499–524.
- Keshet, H., & Gilboa-Schechtman, E. (2017). Symptoms and beyond: Self-concept among sexually assaulted women. *Psychological Trauma: Theory, Research, Practice, and Policy*, 9(5), 545–552.
- King, K. B., Clark, P. C., & Friedman, M. M. (1999). Social comparisons and temporal comparisons after coronary artery surgery. *Heart & Lung: The Journal of Acute and Critical Care*, 28(5), 316–325.
- Korenromp, M. J., Page-Christiaens, G. C., van den Bout, J., Mulder, E. J., & Visser, G. H. (2009). Adjustment to termination of pregnancy for fetal anomaly: A longitudinal study in women at 4, 8, and 16 months. *American Journal of Obstetrics and Gynecology*, 201(2), 160.e1–7.
- 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, 87–109.
- Markman, K. D., & McMullen, M. N. (2003). A reflection and evaluation model of comparative thinking. *Personality and Social Psychology Review*, 7(3), 244–267.
- McFarland, C., & Alvaro, C. (2000). The impact of motivation on temporal comparisons. *Journal of Personality and Social Psychology*, 79(3), 327–343.
- Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine*, 151(4), 264–269.
- Mussweiler, T. (2003). Comparison processes in social judgment: Mechanisms and consequences. *Psychological Review*, 110(3), 472–489.
- Olson, J. M., Buhrmann, O., & Roese, N. J. (2000). Comparing comparisons. In J. Suls & L. Wheeler (Eds.), *Handbook of social comparison* (pp. 379–398). Boston, MA: Springer.
- Redersdorff, S., & Guimond, S. (2005). Comparing oneself over time: The temporal dimension in social comparison. In S. Guimond & S. Guimond (Eds.), *Social comparison and social psychology* (pp. 76–96). Cambridge: Cambridge University Press.
- Roese, N. J. (1994). The functional basis of counterfactual thinking. *Journal of Personality and Social Psychology*, 66(5), 805–818.
- Roese, N. J. (1997). Counterfactual thinking. *Psychological Bulletin*, 121(1), 133–148.
- Roese, N. J., Epstude, K., & Olson, J. M. (2017). The functional theory of counterfactual thinking: New evidence, new challenges, new insights. In J. M. Olson (Ed.), *Advances in experimental social psychology* (Vol. 56; pp. 1–79). Saint Louis, CA: Elsevier Academic Press.
- Roese, N. J., & Olson, J. M. (1997). Counterfactual thinking: The intersection of affect and function. In M. P. Zanna (Ed.), *Advances in experimental social*

- psychology* (Vol. 29; pp. 1–59). San Diego, CA: Academic Press.
- Ross, M., & Wilson, A. E. (2000). Constructing and appraising past selves. In D. L. Schacter & E. Scarry (Eds.), *Memory, brain, and belief* (pp. 231–258). Cambridge, MA: Harvard University Press.
- Rouhani, S. A., Scott, J., Burkhardt, G., Onyango, M. A., Haider, S., Greiner, A., ... Bartels, S. A. (2016). A quantitative assessment of termination of sexual violence-related pregnancies in eastern democratic Republic of Congo. *Conflict And Health, 10*, e9.
- Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin, 86*(2), 420–428.
- Suls, J., Marco, C. A., & Tobin, S. (1991). The role of temporal comparison, social comparison, and direct appraisal in the elderly's self-evaluations of health. *Journal of Applied Social Psychology, 21*(14), 1125–1144.
- Summerville, A., & Roese, N. J. (2008). Dare to compare: Fact-based versus simulation-based comparison in daily life. *Journal of Experimental Social Psychology, 44*(3), 664–671.
- Tabachnik, B., & Fidell, L. (2013). *Using multivariate statistics* (6th ed.). Boston: Allyn and Bacon.
- Taylor, S. E., & Lobel, M. (1989). Social comparison activity under threat: Downward evaluation and upward contacts. *Psychological Review, 96*(4), 569–575.
- Viechtbauer, W. (2005). Bias and efficiency of meta-analytic variance estimators in the random-effects model. *Journal of Educational and Behavioral Statistics, 30*(3), 261–293.
- Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software, 36*(3), 1–48.
- Wilson, J. J., Gil, K. M., & Raezer, L. (1997). Self-evaluation, coping, and depressive affect in African American adults with sickle cell disease. *Cognitive Therapy and Research, 21*(4), 443–457.
- Wood, J. V. (1989). Theory and research concerning social comparisons of personal attributes. *Psychological Bulletin, 106*(2), 213–248.
- Wood, J. V. (1996). What is social comparison and how should we study it? *Personality and Social Psychology Bulletin, 22*(5), 520–537.

Appendix

Table A1. Items for study quality.

(A) Did the study include a clinical sample?
(2) >80% of sample meet diagnostic criteria of PTSD
(1) Between 50%-80% of sample meet diagnostic criteria of PTSD
(0) <50% of sample meet diagnostic criteria of PTSD OR PTSD diagnostic rate is not reported
(B) Was PTSD diagnosis assessed with a validated instrument?
(2) PTSD diagnosis assessed with structured psychiatric interview based on DSM or ICD criteria
(1) PTSD diagnosis assessed with self-report based on validated instrument based on DSM or ICD criteria
(0) PTSD diagnosis assessed with unvalidated instrument OR insufficient information supplied
(C) Was symptom severity of PTSD assessed with a validated instrument?
(2) Symptom severity of PTSD assessed with a clinically-validated instrument
(0) Symptom severity of PTSD assessed with an unvalidated instrument OR insufficient information supplied report on psychometric evaluation OR insufficient information supplied
(D) Was comparison measured with a validated measure?
(2) Comparison was assessed with an instrument that has been validated to measure counterfactual, social, and/or temporal comparisons
(1) Comparison was assessed with a validated measure that does measure a construct that is related to counterfactual, social, and/or temporal comparisons
(0) Comparison was assessed with an unvalidated instrument (e.g. self-construed items without a report on psychometric evaluation) OR insufficient information supplied
(E) Did the assessment of the comparison standard take direction (e.g. upward and downward) into account?
(2) The assessment of comparison took direction into account and authors report results for both directions
(1) The assessment of comparison only took one direction into account
(0) Ambiguous/mixed measure without clear direction OR insufficient information supplied

Table A2. Meta-analytic results for Claycomb et al. (2015).

$Q(3) = 5.8410, p = 0.1196$

	Estimate	95% CI	SE
Fisher's z	.40	[.34;.46]	0.03
r	.38	[.33;.43]	

Table A3. Quality scores for included studies.

Study	Item A	Item B	Item C	Item D	Item E	Total quality score
Bãrliba & Dafinoiu (2015)	0	0	2	1	2	5
Bhushan & Kumar (2012)	0	0	2	0	2	4
Birrer & Michael (2011)	0	1	2	1	0	4
Blix et al. (2016)	0	0	2	0	2	4
Blix et al. (2018)	0	1	2	0	2	5
Boals & Schuettler (2011)	0	0	2	1	0	3
Brauchle (2005)	0	1	2	0	0	3
Brown et al. (2011)	1	2	2	0	0	5
Claycomb et al. (2015)	0	1	2	1	0	4
Clohessy & Ehlers (1999)	0	1	2	0	0	3
Dalgleish (2004), study 1	0	1	2	0	2	5
Dalgleish (2004), study 2	0	2	2	0	2	6
Dirkzwager et al. (2003)	0	0	2	1	0	3
Dougall et al. (2001)	0	2	0	1	0	3
Dunmore et al. (1999)	1	1	2	0	0	4
Dunmore et al. (2001)	0	0	2	0	0	2
El Leithy et al. (2006)	0	1	2	0	2	5
Erwin et al. (2018)	0	1	2	1	0	4
Fairbank et al. (1991)	0	2	2	1	0	5
Gilbar et al. (2010)	1	1	2	1	2	7
Hooberman et al. (2010)	0	1	2	0	2	5
Kelley et al. (2019)	0	0	2	1	0	3
Lee et al. (2018)	0	0	2	1	0	3
Marsac et al. (2011)	0	0	2	1	0	3
Michael et al. (2007) ^a	0	1	2	0	0	3
Michael et al. (2007) ^b	0	1	2	0	0	3
Miller et al. (2010)	0	0	2	0	0	2
Mitchell et al. (2016)	0	1	2	1	0	4
Mizota et al. (2006)	1	1	2	0	0	4
Morris et al. (2012)	0	1	2	1	2	6
Patanwala et al. (2017)	0	1	2	1	0	4
Pole et al. (2005)	0	0	2	1	0	3
Roley et al. (2015)	1	1	2	1	0	5
Roth et al. (2011)	0	2	2	1	2	7
Troop & Hiskey (2013)	1	1	2	1	0	5
Tsay et al. (2001)	0	0	2	1	0	3
Valentiner et al. (1996)	0	1	2	1	0	4
Ye et al. (2018)	0	1	2	1	0	4

References of studies included in review and meta-analysis

- †Bârliba, R. G., & Dafinoiu, I. (2015). The hindsight bias effect and counterfactual thinking: Clinical predictors. *Journal of Evidence-Based Psychotherapies*, 15(1), 121–133.
- †Bhushan, B., & Kumar, J. S. (2012). A study of posttraumatic stress and growth in tsunami relief volunteers. *Journal of Loss and Trauma*, 17(2), 113–124. <https://doi.org/10.1080/15325024.2011.635580>
- †Birrer, E., & Michael, T. (2011). Rumination in PTSD as well as in traumatized and non-traumatized depressed patients: A cross-sectional clinical study. *Behavioural and Cognitive Psychotherapy*, 39(4), 381–397. <https://doi.org/10.1017/S1352465811000087>
- *Blix, I., Kanten, 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>
- *8Blix, I., Kanten, 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. <https://doi.org/10.3389/fpsyg.2018.00515>
- *Boals, A., & Schuettler, D. (2011). A double-edged sword: Event centrality, PTSD and posttraumatic growth. *Applied Cognitive Psychology*, 25(5), 817–822. <https://doi.org/10.1002/acp.1753>
- *Brauchle, G. (2005). Das Gletscherbahnunglück von Kaprun in Österreich im Jahr 2000: Maladaptive Copingstrategien, Intrusionen und Posttraumatische Belastungsstörungen bei Kriminalbeamten. *Zeitschrift für Gesundheitspsychologie*, 13(4), 167–174. <https://doi.org/10.1026/0943-8149.13.4.167>
- †Brown, A. D., Buckner, J. P., & Hirst, W. (2011). Time, before, and after time: Temporal self and social appraisals in posttraumatic stress disorder. *Journal of Behavior Therapy and Experimental Psychiatry*, 42(3), 344–348. <https://doi.org/10.1016/j.jbtep.2011.02.006>
- *Claycomb, M. A., Wang, L., Sharp, C., Ractliffe, K. C., & Elhai, J. D. (2015). Assessing relations between PTSD's dysphoria and reexperiencing factors and dimensions of rumination. *Public Library of Sciences ONE*, 10(3), e0118435–e0118435. <https://doi.org/10.1371/journal.pone.0118435>
- *Clohessy, S., & Ehlers, A. (1999). PTSD symptoms, response to intrusive memories and coping in ambulance service workers. *British Journal of Clinical Psychology*, 38, 251–265.
- †Dalglish, 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>
- *Dirkzwager, A. J., Bramsen, I., & van der Ploeg, H. M. (2003). Social support, coping, life events, and posttraumatic stress symptoms among former peacekeepers: A prospective study. *Personality and Individual Differences*, 34(8), 1545–1559.
- †Dougall, A. L., Ursano, R. J., Posluszny, D. M., Fullerton, C. S., & Baum, A. (2001). Predictors of posttraumatic stress among victims of motor vehicle accidents. *Psychosomatic Medicine*, 63(3), 402–411.
- *Dunmore, E., Clark, D. M., & Ehlers, A. (1999). Cognitive factors involved in the onset and maintenance of posttraumatic stress disorder (PTSD) after physical or sexual assault. *Behaviour Research and Therapy*, 37(9), 809–829.
- *Dunmore, E., Clark, D. M., & Ehlers, A. (2001). A prospective investigation of the role of cognitive factors in persistent Posttraumatic Stress Disorder (PTSD) after physical or sexual assault. *Behaviour Research and Therapy*, 39(9), 1063–1084. [https://doi.org/10.1016/S0005-7967\(00\)00088-7](https://doi.org/10.1016/S0005-7967(00)00088-7)
- *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>
- *Erwin, M. C., Mitchell, M. A., Contractor, A. A., Dranger, P., Charak, R., & Elhai, J. D. (2018). The relationship between distress tolerance regulation, counterfactual rumination, and PTSD symptom clusters. *Comprehensive Psychiatry*, 82, 133–140. <https://doi.org/10.1016/j.comppsy.2018.01.012>
- †Fairbank, J. A., Hansen, D. J., & Fitterling, J. M. (1991). Patterns of appraisal and coping across different stressor conditions among former prisoners of war with and without posttraumatic stress disorder. *Journal of Consulting and Clinical Psychology*, 59(2), 274–281.
- †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 and Trauma*, 15(4), 304–324. <https://doi.org/10.1080/15325020903382350>
- †Hooberman, J., Rosenfeld, B., Rasmussen, A., & Keller, A. (2010). Resilience in trauma-exposed refugees: the moderating effect of coping style on resilience variables. *American Journal of Orthopsychiatry*, 80(4), 557–563. <https://doi.org/10.1111/j.1939-0025.2010.01060.x>
- *Kelley, M. L., Bravo, A. J., Hamrick, H. C., Braitman, A. L., & Judah, M. R. (2019). Killing during combat and negative mental health and substance use outcomes among recent-era veterans: The mediating effects of rumination. *Psychological Trauma: Theory, Research, Practice and Policy*, 11(4), 379–382. <https://doi.org/10.1037/tra0000385>
- *Lee, J. H., Park, S., & Sim, M. (2018). Relationship between ways of coping and posttraumatic stress symptoms in firefighters compared to the general population in South Korea. *Psychiatry Research*, 270, 649–655. <https://doi.org/10.1016/j.psychres.2018.10.032>
- †Marsac, M. L., Donlon, K. A., Winston, F. K., & Kassam-Adams, N. (2011). Child coping, parent coping assistance, and post-traumatic stress following paediatric physical injury. *Child: Care, Health and Development*, 39(2), 171–177. <https://doi.org/10.1111/j.1365-2214.2011.01328.x>
- *Michael, T., Halligan, S. L., Clark, D. M., & Ehlers, A. (2007). Rumination in posttraumatic stress disorder. *Depression and Anxiety*, 24(5), 307–317. <https://doi.org/10.1002/da.20228>
- †Miller, A. K., Handley, I. M., Markman, K. D., & Miller, J. H. (2010). Deconstructing self-blame following sexual assault: The critical roles of cognitive content and process. *Violence Against Women*, 16(10), 1120–1137. <https://doi.org/10.1177/1077801210382874>
- *Mitchell, M. A., Contractor, A. A., Dranger, P., & Shea, M. T. (2016). Unique relations between counterfactual thinking and DSM-5 PTSD symptom clusters. *Psychological Trauma: Theory, Research, Practice and Policy*, 8(3), 293–300. <https://doi.org/10.1037/tra0000089>
- *Mizota, Y., Ozawa, M., Yamazaki, Y., & Inoue, Y. (2006). Psychosocial problems of bereaved families of HIV-infected hemophiliacs in Japan. *Social Science &*

- Medicine* (1982), 62(10), 2397–2410. <https://doi.org/10.1016/j.socscimed.2005.10.032>
- †Morris, B. A., Chambers, S. K., Campbell, M., Dwyer, M., & Dunn, J. (2012). Motorcycles and breast cancer: The influence of peer support and challenge on distress and posttraumatic growth. *Supportive Care in Cancer*, 20(8), 1849–1858. <https://doi.org/10.1007/s00520-011-1287-5>
- *Patanwala, M., Tieu, L., Ponath, C., Guzman, D., Ritchie, C. S., & Kushel, M. (2017). Physical, psychological, social, and existential symptoms in older homeless-experienced adults: An observational study of the hope home cohort. *Journal of General Internal Medicine*, 33(5), 635–643. <https://doi.org/10.1007/s11606-017-4229-1>
- *Pole, N., Best, S. R., Metzler, T., & Marmar, C. R. (2005). Why are hispanics at greater risk for PTSD? *Cultural Diversity and Ethnic Minority Psychology*, 11(2), 144–161. <https://doi.org/10.1037/1099-9809.11.2.144>
- *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>
- †Roth, J., Steffens, M. C., Morina, N., & Stangier, U. (2011). Changed for the worse: Subjective change in implicit and explicit self-esteem in individuals with current, past, and no posttraumatic stress disorder. *Psychotherapy and Psychosomatics*, 81(1), 64–66. <https://doi.org/10.1159/000329993>
- †Troop, N. A., & Hiskey, S. (2013). Social defeat and PTSD symptoms following trauma. *British Journal of Clinical Psychology*, 52(4), 365–379. <https://doi.org/10.1111/bjc.12022>
- †Tsay, S. L., Halstead, M. T., & McCrone, S. (2001). Predictors of coping efficacy, negative moods and post-traumatic stress syndrome following major trauma. *International Journal of Nursing Practice*, 7(2), 74–83.
- *Valtiner, D. P., Foa, E. B., Riggs, D. S., & Gershuny, B. S. (1996). Coping strategies and posttraumatic stress disorder in female victims of sexual and nonsexual assault. *Journal of Abnormal Psychology*, 105(3), 455–458.
- *Ye, Z., Chen, L., & Lin, D. (2018). The relationship between posttraumatic stress disorder symptoms and posttraumatic growth among HIV-infected men who have sex with men in Beijing, China: The mediating roles of coping strategies. *Frontiers in Psychology*, 9, 1787. <https://doi.org/10.3389/fpsyg.2018.01787>
- †Included in both, meta-analysis and systematic review.
*Included in the narrative review only.