Perspectives on Self-Reported Resilience - Cross-Sectional, Longitudinal, and Meta-Analytical Considerations

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Abstract

Resilience may describe a personality trait, an outcome - meaning the absence of psychopathological symptoms - or an active process of adaption. The current thesis comprises five studies concerning trait-resilience and other resilience-related, health-benefitting factors including sense of coherence (SOC), the key component of the salutogenesis framework. *Study 1* investigated the relationship between SOC and posttraumatic stress symptoms using meta-analytical methods. Findings based on predominantly cross-sectional studies demonstrated a robust relationship between SOC and psychopathological symptoms, $M(r) = -.41$, indicating that a stronger SOC is related to less severe symptoms. Two field studies (*Studies 2* and *3*) assessed this relationship in occupations at risk for trauma and investigated the potential overlap between different health-benefitting concepts. Both studies identified SOC as the most important correlate of psychopathological symptoms, whereas other concepts (i.e., trait-resilience and locus of control) were less important. *Study 4* used a longitudinal design and found that higher pre-treatment SOC levels were predictive of better treatment outcomes. A comprehensive meta-analytical project (*Study 5*) investigated the bivariate relationships between different health-benefitting factors and posttraumatic stress symptoms. SOC was identified as the most important correlate, while other health-benefitting factors (i.e., trait-resilience/hardiness, locus of control/sense of mastery, self-efficacy, dispositional optimism, and openness to experience) did not show incremental validity beyond SOC using meta-analytical regression models. Thus, the results of the current thesis underline the importance of SOC as a correlate of psychopathological symptoms as well as the strong need for longitudinal research allowing for an empirical test of the salutogenesis model.

Summary

Resilience describes the active process of adaptation following exposure to an aversive life event, trauma, tragedy, and any other significant threat or stressors. Such stressors may be family and relationship problems, serious health problems, conflicts at work or financial difficulties. In this context, resilience is defined as the ability to 'bounce back' after trauma and aversity, going beyond the mere absence of psychopathological symptoms. On the contrary, in recent research resilience is conceptualized as an active and dynamic process of coping with challenging life events. However, despite this broad definition, there are different conceptualizations of resilience: early research into resilience mainly regarded resilience as an outcome, i.e., the absence of relevant psychopathological symptoms. Another approach described resilience as a more or less stable personality trait, so called trait-resilience. Following this conceptualization individuals differ in their capacity to deal with stressors. Notably, multiple concepts exist that are similar to trait-resilience, including sense of coherence as the key component of Antonovsky's (1979, 1987) salutogenesis framework, hardiness (Kobasa, 1979), (internal) locus of control (Rotter, 1966), self-efficacy (Bandura, 1977), dispositional optimism (Scheier & Carver, 1985), sense of mastery (Pearlin & Schooler, 1978), and openness to experience (Costa & McCrae, 1992). Many studies reported robust relationships between these health-benefitting concepts and general mental health problems, as well as symptoms of posttraumatic stress disorder (PTSD) after traumatic life events. Despite the substantial conceptual overlap between these concepts, which is also evident in strong intercorrelations, there is only a small number of studies targeting their conceptual and empirical vagueness by assessing more than one health-benefitting factor at a time. Moreover, a meta-analysis on the relationship between these concepts and psychopathological symptom burden is entirely missing.

The current thesis comprises five studies that shed light on the relationship between different health-benefitting factors and psychopathological symptoms using field studies and meta-analyses. *Study 1* is the first study to investigate the relationship between sense of coherence and PTSD symptoms after aversive life events on a meta-analytical level. Based on 47 samples reported in 45 studies the meta-analysis revealed a robust cross-sectional relationship between sense of coherence and PTSD symptoms, *M(r)* = -.41. Hence, sense of coherence and posttraumatic stress symptoms shared 17% of their variance. In spite of substantial remaining heterogeneity among effect sizes, there were no moderating effects of trauma type and sample characteristics. However, since the meta-analysis only focused on sense of coherence and PTSD symptoms, it remained unclear how much variance is uniquely accounted for by sense of coherence and which proportions overlap with other health-benefitting factors.

This potential overlap is addressed by *Study 2* and *3*. Both studies assessed health-benefitting factors (i.e., sense of coherence, locus of control, and trait-resilience) in populations at risk for traumatization and critical incidents (hereinafter referred to as high-risk populations). Examples of such occupations are intensive care unit staff, first responders, military populations, police officers, and firefighters. *Study 2* identified sense of coherence as the strongest health-benefitting correlate of general mental health

problems and PTSD symptoms in a sample of staff members of an intensive care unit and an anesthesiology unit ($N = 52$). Analyzed in a joint model, neither trait-resilience nor (internal and external) locus of control showed incremental validity beyond sense of coherence. Similar results were found in *Study 3*, which reported on a larger online survey ($N = 580$) including medical staff, police officers, and firefighters. In line with *Study 2*, sense of coherence showed the strongest association with PTSD symptoms, general mental health problems, and burnout symptoms. Interestingly, this finding was consistent across all high-risk occupations. Police officers exhibited a stronger external and weaker internal locus of control compared to both, medical staff and firefighters. Contrasting the regression models predicting health based on all health-benefitting factors across all occupations, no differences were evident for general mental health problems. However, regarding PTSD symptoms, there was a particularly strong association with external locus of control in police officers compared to both other groups.

While both studies evidenced a strong cross-sectional relationship between sense of coherence and psychopathological symptom burden, there is a substantial lack of longitudinal research into salutogenesis. *Study 4* aimed to address this gap by studying the ability of sense of coherence to predict treatment outcomes of a multidisciplinary 5/6-week inpatient psychosomatic rehabilitation program ($N = 294$). Pre-treatment levels of sense of coherence were used to predict post-treatment outcomes whilst accounting for pre-treatment psychopathological symptom severity. Sense of coherence explained a small but significant amount of variance in pre-to-post changes. However, future studies need to replicate these findings using different interventions in diverse settings.

Study 5 of the dissertation project, again as in *Studies 1* to *3*, adopted a cross-sectional approach and replicated the findings of the meta-analysis on the relationship between sense of coherence and PTSD symptoms in *Study 1*. However, this large-scale meta-analytical project included multiple health-benefitting factors in addition to sense of coherence. Thereby, the project provided a first meta-analytical estimation of the bivariate cross-sectional relationships between PTSD symptoms and different health-benefitting factors (i.e., trait-resilience, hardiness, internal and external locus of control, self-efficacy, sense of mastery, dispositional optimism, and openness to experience). Moreover, for the first time, the project studied a potential integration of different concepts using meta-analytical methods by comparing indices of heterogeneity between individual and combined meta-analyses. Additionally, the project provided a first estimation of the incremental validity of important health-benefitting factors. Based on 44 studies, the meta-analysis replicated the strong relationship between sense of coherence and PTSD symptoms, $M(r) = -.40$. Concerning the bivariate associations, the confidence intervals of external locus of control, hardiness, and sense of mastery overlap with those of sense of coherence indicating no significant differences between these concepts. Building on theoretical assumptions, the concepts of trait-resilience and hardiness can be combined to a common resilience factor since their joint analysis does not result in an increase in heterogeneity. The same applied to (internal and external) locus of control and sense of mastery, which together constituted a control factor. Comparing the relationships between these combined factors and PTSD symptoms with sense of coherence, the confidence intervals no longer

overlapped, supporting a particular strong relationship between sense of coherence and PTSD symptoms. Applying meta-analytical path models, the resilience factor as well as the control factor did not demonstrate incremental validity beyond sense of coherence for the prediction of PTSD symptoms. In contrast, sense of coherence still demonstrated incremental validity when controlling for resilience and control beliefs.

The results of the current dissertation project support sense of coherence's role as the most important health-benefitting correlate of psychopathological symptoms following adversity using a multi-method approach consisting of meta-analyses and field studies. Furthermore, they provide first evidence that sense of coherence constitutes a relevant predictor of psychotherapy outcomes. Building on these findings the current thesis has three implications for future research on resilience: firstly, studies should concentrate on sense of coherence as a particular important health-benefitting factor related to psychopathological symptoms after stressful life events. In cross-sectional studies, other health-benefitting factors seem to be redundant as they do not exhibit incremental validity beyond sense of coherence. Secondly, studies should focus on the longitudinal association between sense of coherence and psychopathological symptoms. Thirdly, there is a strong need for studies investigating more than bivariate associations between health-benefitting factors and psychopathological symptoms. Future research should test the empirical assumptions of the salutogenesis framework, which comprises relevant factors beyond sense of coherence as its key component, including various resources assumed to moderate and/or mediate coping processes. Only the definition of such a system, with sense of coherence as its key component, and the study of its mechanisms and processes are able to inform comprehensive primary and secondary prevention strategies for stressor-related mental disorders in the long-term.

Kurzzusammenfassung

Resilienz kann sowohl als Persönlichkeitsmerkmal, als Ergebnis – im Sinne der Abwesenheit von Symptomen – als auch als aktiver Prozess verstanden werden. Die vorliegende Dissertation umfasst fünf Studien, die sich mit Resilienz als Persönlichkeitsmerkmal und konkurrierenden Konstrukten befassen, wie etwa Kohärenzerleben (*sense of coherence*, SOC) als Kernelement des Salutogenese-Ansatzes. *Studie 1* untersuchte den Zusammenhang zwischen SOC und Symptomen posttraumatischer Belastung metaanalytisch. Die Ergebnisse zeigen, dass SOC in den überwiegend querschnittlichen Studien ein robustes Korrelat der Symptombelastung darstellt, *M(r)* = -.41. Ein höheres SOC ist mit einer geringeren Symptombelastung verbunden. Zwei Feldstudien (*Studien 2* und *3*) untersuchten diesen Zusammenhang in Risiko-Berufsgruppen sowie Schnittmengen mit konkurrierenden Konstrukten. Beide Studien identifizierten SOC als zentrales Korrelat psychopathologischer Belastung, konkurrierende Konstrukte haben nur eine untergeordnete Bedeutung. *Studie 4* nutzte einen längsschnittlichen Ansatz und konnte zeigen, dass Patienten mit höherem SOC zu Beginn der Behandlung stärker von einer fünf- bis sechswöchigen stationären Rehabilitationsmaßnahme profitieren. Eine umfassende Metaanalyse (*Studie 5*) untersuchte schließlich den Zusammenhang verschiedener Resilienz-assoziierter Konstrukte mit posttraumatischer Belastung. Erneut erwies sich SOC als zentrales Belastungskorrelat. Alle übrigen Resilienz-assoziierten Konstrukte (Resilienz als Persönlichkeitsmerkmal/*Hardiness*, Kontroll-überzeugungen/*Sense of Mastery*, Selbstwirksamkeit, dispositionaler Optimismus und Offenheit für Erfahrungen) wiesen signifikant geringere Zusammenhänge auf und hatten in einem metaanalytischen Regressionsmodell keine inkrementelle Validität gegenüber SOC. Diese Ergebnisse unterstreichen die Bedeutung von SOC, jedoch auch die Relevanz von Längsschnittstudien, die das Salutogenese-Modell als solches einer empirischen Prüfung zugänglich machen.

Zusammenfassung

Resilienz beschreibt den aktiven Anpassungsprozess, wenn ein Individuum mit einem stark aversiven Lebensereignis, einem Trauma, einer Tragödie oder einem anderen relevanten Stressor konfrontiert ist. Solche Stressoren können vielfältiger Natur sein – dazu zählen familiäre Probleme, ernsthafte Erkrankungen, Schwierigkeiten am Arbeitsplatz oder finanzielle Belastungen. Resilienz bedeutet, schwierige Lebensereignisse auf lange Sicht gut zu bewältigen. Dieser Definition zu Folge ist Resilienz mehr als die Abwesenheit von Psychopathologie nach Belastung, sondern ein aktiver und dynamischer Prozess des Umgangs mit schwierigen und belastenden Lebenssituationen. Neben dieser vor allem in jüngeren Arbeiten zugrunde gelegten Definition existieren weitere Konzeptualisierungen des Resilienz-Begriffs: So versteht eine (allerdings zunehmend überholte) Forschungstradition Resilienz noch immer als ‚Ergebnis' – als das Fehlen von Symptombelastung. Eine weitere Forschungstradition hingegen beschreibt Resilienz als Persönlichkeitsmerkmal (Englisch *trait-resilience*) und damit als interindividuell variierende Kapazität, mit Stressoren umgehen zu können. Dieser Ansatz jedoch ist nicht ohne Alternative, und so existieren zahlreiche Konzepte gesundheitsförderlicher, Resilienz-assoziierter Faktoren, die in inhaltlicher Konkurrenz zum Konzept von Resilienz als Persönlichkeitsmerkmal stehen. Hierzu zählen vor allem Kohärenzerleben als Kernelement des Salutogenese-Ansatzes nach Antonovsky (1979, 1987), Hardiness (Kobasa, 1979), Kontrollüberzeugungen (Englisch *Locus of Control*) (Rotter, 1966), Selbstwirksamkeit (Bandura, 1977), dispositionaler Optimismus (Scheier & Carver, 1985), *Sense of Mastery* (Pearlin & Schooler, 1978) und Offenheit für Erfahrungen (Costa & McCrae, 1992). Zahlreiche Studien zeigen Zusammenhänge zwischen diesen Konstrukten, allgemeiner psychopathologischer Belastung und Symptomen der posttraumatischen Belastungsstörung (PTBS). Trotz ihrer inhaltlichen Schnittmengen, die auch in substanziellen Korrelationen deutlich werden, liegen nur wenige Arbeiten vor, die sich mit der konzeptuellen und oftmals auch empirischen Unschärfe befassen. Eine metaanalytische Untersuchung fehlte bis dato vollständig.

Die vorliegende Dissertation umfasst fünf Studien, die sich aus unterschiedlicher Perspektive – in Form dreier Feldstudien und zweier Metaanalysen – mit Resilienz sowie Resilienz-assoziierten Konzepten befassen. Dabei untersuchte *Studie 1* den Zusammenhang zwischen Kohärenzerleben und Symptomen posttraumatischer Belastung nach aversiven Lebensereignissen erstmals metaanalytisch. Auf Basis von 47 Stichproben, die in 45 Einzelstudien untersucht wurden, konnte die Metaanalyse einen robusten querschnittlichen Zusammenhang von $M(r) = -.41$ zeigen. Damit teilten Kohärenzerleben und PTBS-Symptome 17 Prozent ihrer Varianz. Trotz vorhandener Heterogenität ließen sich keine Moderatoreffekte durch Charakteristika des Traumas oder der Stichprobe zeigen. Da die Metaanalyse jedoch lediglich den Zusammenhang zwischen Kohärenzerleben und PTBS-Symptomen betraf, blieb zunächst offen, welcher Varianzanteil einzigartig auf Kohärenzerleben zurückgeht und inwiefern dieses Schnittmengen mit konkurrierenden Konstrukten aufweist.

Inwiefern sich de facto Schnittmengen mit verwandten Konstrukten ergeben, untersuchten *Studien 2* und *3* der Arbeit. Beide befassten sich mit gesundheitsförderlichen Faktoren (Kohärenzerleben, Kontrollüberzeugungen sowie Resilienz als Persönlichkeitsmerkmal) in Risikopopulationen. Als solche werden Personengruppen verstanden, die einem erhöhten Risiko ausgesetzt sind, aversive und traumatische Ereignisse zu erleben. Hierzu zählen beispielsweise besonders belastete Berufsgruppen, wie Intensivmediziner, Rettungskräfte, Soldaten, Polizisten oder Feuerwehrfrauen und -männer. In *Studie 2* identifizierte eine Online-Befragung von Mitarbeitern einer Intensivstation und einer Anästhesie-Abteilung ($N = 52$) Kohärenzerleben als zentrales Resilienz-assoziiertes Korrelat von PTBS-Symptomen und allgemeiner psychopathologischer Symptombelastung. Sowohl Kontrollüberzeugungen als auch Resilienz als Persönlichkeitsmerkmal wiesen keine inkrementelle Validität über Kohärenzerleben hinaus auf. Ein ähnliches Ergebnismuster zeigte sich in *Studie 3* in einer größer angelegten Online-Befragung ($N = 580$) von medizinischem Personal, Polizisten sowie Feuerwehrfrauen und -männern. Auch hier fanden sich die stärksten Zusammenhänge zwischen Kohärenzerleben und PTBS-Symptomen, allgemeiner psychopathologischer Symptombelastung und Burnout-Symptomen. Ein Vergleich zwischen den verschiedenen Berufsgruppen lieferte ein konsistentes Befundmuster: Kohärenzerleben war das stärkste Korrelat. Polizisten zeigten jedoch, verglichen mit den beiden übrigen Berufsgruppen, eine stärker externale Kontrollüberzeugung. Vergleicht man die Regressionsmodelle, so fanden sich keine Unterschiede zwischen den untersuchten Berufsgruppen im Hinblick auf allgemeine psychopathologische Symptome, während sich ein besonders starker positiver Zusammenhang zwischen externalen Kontrollüberzeugungen und PTBS-Symptomen bei Polizisten zeigte.

Während beide Studien einen starken querschnittlichen Zusammenhang zwischen Kohärenzerleben und psychopathologischer Belastung unterstrichen, besteht ein deutlicher Mangel an Längsschnitt-Studien, die sich mit dem Salutogenese-Ansatz befassen. *Studie 4* schloss diese Lücke im Kontext stationärer psychosomatischer Rehabilitation ($N = 294$), indem sie den prädiktiven Wert von Kohärenzerleben zum Zeitpunkt der Aufnahme in der Klinik für die Symptomreduktion untersuchte. Sowohl im Hinblick auf depressive Symptome als auch auf die allgemeine psychopathologische Symptombelastung zeigte Kohärenzerleben einen kleinen, jedoch signifikanten inkrementellen Vorhersagebeitrag über die Symptombelastung zum Aufnahmezeitpunkt hinaus. Dabei erlebten Personen mit stärkerem Kohärenzerleben zu Beginn der Rehabilitationsmaßnahme eine größere Symptomreduktion in Folge der fünf- bis sechswöchigen Intervention. Weitere Studien müssen zeigen, ob sich diese Befunde auch in anderen therapeutischen Settings replizieren lassen.

Die abschließende *Studie 5* des Dissertationsprojekts verfolgte wieder einen querschnittlichen Ansatz und replizierte die Befunde aus *Studie 1* im Hinblick auf den Zusammenhang zwischen Kohärenzerleben und PTBS-Symptomen. Anders als *Studie 1* ist das Metaanalyse-Projekt jedoch breiter angelegt und untersuchte auch die Zusammenhänge zwischen PTBS-Symptomen und weiteren Resilienz-assoziierten Konzepten (das heißt Resilienz als Persönlichkeitsmerkmal, *Hardiness*, Kontrollüberzeugungen, Selbstwirksamkeit, *Sense of Mastery*, dispositionalem Optimismus und Offenheit für neue Erfahrungen)

erstmals metaanalytisch. Darüber hinaus prüfte das Metaanalyse-Projekt erstmals die mögliche Integration verschiedener theoretischer Konzepte auf Basis statistischer Heterogenitätskennwerte und untersuchte potenzielle inkrementelle Varianzanteile der einzelnen Konstrukte. Auf Basis von 47 Studien konnte der starke Zusammenhang zwischen Kohärenzerleben und PTBS-Symptomen repliziert werden, *M(r)* = -.40. Zunächst zeigten sowohl externale Kontrollüberzeugungen, *Sense of Mastery* als auch *Hardiness* mit Kohärenzerleben überlappende Konfidenzintervalle, und damit keine signifikanten Unterschiede. In einem zweiten Schritt konnten jedoch externale und internale Kontrollüberzeugungen sowie *Sense of Mastery* zu einem übergeordneten Kontrollfaktor integriert werden. Auch Resilienz als Persönlichkeitsmerkmal und *Hardiness* ließen sich zu einem Resilienzfaktor zusammenfassen. Die Konfidenzintervalle der beiden integrierten Faktoren überlappten nicht länger mit dem von Kohärenzerleben. Unter Nutzung metaanalytischer Pfadmodelle wurden sowohl die inkrementelle Validität des Kontroll- (*Locus of Control* und *Sense of Mastery*) als auch des Resilienzfaktors (Resilienz als Persönlichkeitsmerkmal und *Hardiness*) über Kohärenzerleben hinaus geprüft: Keiner der beiden Faktoren teilte über Kohärenzerleben hinaus signifikant Varianz mit PTBS-Symptomen, wobei Kohärenzerleben in beiden Fällen bedeutsame inkrementelle Validität aufwies.

Die Ergebnisse des vorliegenden Dissertationsprojekts identifizieren Kohärenzerleben – in zwei Metaanalysen sowie durch drei Feldstudien – als zentrales Korrelat psychopathologischer Symptombelastung nach belastenden oder traumatischen Lebensereignissen. Darüber hinaus liefert die Arbeit erste Hinweise, dass Kohärenzerleben auch im Kontext von Psychotherapie einen bedeutsamen Prädiktor der Symptomreduktion darstellen könnte. Vor diesem Hintergrund ergaben sich vor allem drei Implikationen für zukünftige Studien im Kontext von Resilienz: Erstens sollten Studien sich vor allem auf Kohärenzerleben als gesundheitsförderliches, Resilienz-assoziiertes Konstrukt konzentrieren, da die übrigen Konstrukte keine inkrementelle Validität über Kohärenzerleben hinaus aufweisen. Zweitens sollten Forschungsprojekte vor allem den Zusammenhang von Kohärenzerleben und psychopathologischer Symptombelastung im Längsschnitt untersuchen. Drittens bedarf es dringend einer Prüfung von mehr als nur bivariaten Assoziationen zwischen Resilienz-assoziierten Konstrukten und psychopathologischer Symptombelastung. Vielmehr sollte eine empirische Überprüfung des Salutogenese-Modells erfolgen, das Kohärenzerleben, allerdings auch weitere Ressourcen als mediierende und/oder moderierende Faktoren annimmt. Nur durch die Definition eines solchen Systems – mit Kohärenzerleben als zentraler Komponente – und durch die Untersuchung der in diesem wirkenden Mechanismen und Prozesse könnten langfristig umfassende und multi-methodische Ansätze zur primären und sekundären Prävention stress-induzierter psychischer Erkrankungen entstehen und weiterentwickelt werden.

List of Manuscripts

This dissertation is based on five articles that are published in international peer-reviewed journals, submitted to international peer-reviewed journals or in preparation to be submitted to international peer-reviewed journals. I am the first author of these manuscripts, but other authors also contributed substantially to these manuscripts and are listed below. While these articles are not presented word-by-word in the dissertation, single paragraphs of the introduction and discussion section include content similar to the published or submitted articles.

Study 1

Schäfer, S. K., Becker, N., King, L., Horsch, A., & Michael, T. (2019). The relationship between sense of coherence and post-traumatic stress: a meta-analysis. *European Journal of Psychotraumatology*, 10(1), 1562839. DOI 10.1080/20008198.2018.1562839

Study 2

Schäfer, S. K., Lass-Hennemann, J., Groesdonk, H., Volk, T., Bomberg, H., Staginnus, M., ... & Michael, T. (2018). Mental health in anesthesiology and ICU staff: Sense of Coherence matters. *Frontiers in Psychiatry*, *9*. DOI 10.3389/fpsyt.2018.00440

Study 3

Schäfer, S. K., Sopp, R., Staginnus, M., Lass-Hennemann, J., & Michael, T. (2019). Correlates of mental health in occupations at risk for traumatization: A cross-sectional study. Submitted for publication.

Study 4

Schäfer, S. K., Schanz, C. G., Sopp, R., Lass-Hennemann, J., Käfer, M., & Michael, T. (2019). Pre-Rehabilitation Sense of Coherence as a Predictor of Rehabilitation Outcomes. Submitted for publication.

Study 5

Schäfer, S. K., Sopp, R., Wirth, B., Schanz, C. G., Staginnus, M., Becker, N., & Michael, T. (2019). The relationships between resilience-related concepts and PTSD symptom severity: A meta-analytical investigation. In preparation.

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List of Abbreviations

BDI-II	Beck Depression Inventory II
CD-RISC	Connor-Davidson Resilience Scale
CFA	confirmatory factor analysis
EMA	ecological momentary assessment
ESM	experience sampling method
ICU	intensive care unit
IES(-R)	Impact of Event Scale(-Revised)
IE-4	four-item scale for the assessment of control beliefs
ISR	ICD-10-Symptom-Rating
GRR	generalized resistance resources
Health-49	Hamburger Module zur Erfassung allgemeiner Aspekte psychosozialer Gesundheit für die therapeutische Praxis
HEDE	Health Ease and DisEase
LOC	locus of control
MBSR	mindfulness-based stress reduction
RS-11	Resilience Scale 11
SEM	structural equation modeling
SOC	sense of coherence
SOC-L9	Sense of Coherence Scale - L9
SOC-R	Sense of Coherence Scale - Revised
SOC-13	Sense of Coherence Scale - 13-item version
SRR	specific resistance resources
PCL-5	PTSD checklist for DSM-5
PTSD	posttraumatic stress disorder
WHO	World Health Organization

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To remain with the metaphor: we are all, always, in the dangerous river of life. The twin question is:
How dangerous is our river? How well can we swim?
Aaron Antonovsky (1996, p. 14)

1 INTRODUCTION

Approximately 70% of the global civilian population report the experience of at least one traumatic event during their lifetime (Benjet et al., 2016; Liu et al., 2017). Even in regions that are regularly associated with low rates of violence such as Europe (Krug, Mercy, Dahlberg, & Zwi, 2002), rates of trauma exposure remain high, ranging from 29% in Bulgaria to 85% in the Ukraine (Benjet et al., 2016). Moreover, epidemiological studies may underestimate the prevalence of trauma due to recall errors (Belli, 2014) and unreported events that may be perceived as embarrassing or that are culturally sensitive (Schaeffer, 1999). Thus, lifetime exposure to at least one traumatic event appears to be the norm rather than the exception in the global general population. Six to 59% of those exposed to trauma develop symptoms of acute distress (Kliem & Kröger, 2013). Of those 15 to 30% will be diagnosed with posttraumatic stress disorder (PTSD), a frequent stressor-related disorder (Santiago et al., 2013). However, other mental health issues such as depression and general anxiety disorder may also occur following exposure to trauma and exhibit a complex interrelationship with PTSD as they constitute both pre-traumatic risk factors and common comorbidities (Contractor et al., 2015; Price & van Stolk-Cooke, 2015). The risk of PTSD development is strongly related to the type of trauma. A recent epidemiological study by the World Health Organization (WHO) comprising 68,895 respondents from 24 countries demonstrated that traumas related to intimate partner sexual violence accounted for 43% of the burden[1] caused by traumatic experiences (Kessler et al., 2017), while PTSD following accidental traumas (e.g., severe traffic accidents) is less prevalent (Guest, Tran, Gopinath, Cameron, & Craig, 2018; Kenardy et al., 2017). Spontaneous remission of PTSD is rare, and untreated cases cause a considerable individual and societal burden (Pagotto et al., 2015; Tøien, Bredal, Skogstad, Myhren, & Ekeberg, 2011), which is also reflected in substantial health-care costs (Lamoureux-Lamarche, Vasiliadis, Préville, & Berbiche, 2016; Olesen et al., 2012).

However, despite the high rates of trauma exposure, lifetime prevalence of PTSD in the general population is much lower, ranging from 0.3% in China to 9% in Canada (Dückers, Alisic, & Brewin, 2016). Thus, most individuals exposed to traumatic events are able to rebuild or maintain their mental health even when faced with trauma and/or persisting stressful circumstances. Given these diverging responses to traumatic stressors, it is crucial to identify factors that enable individuals to cope with stressors in a beneficial way. Finding these factors could constitute the foundation for effective primary

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[1] Population burden of PTSD per trauma type was defined as the number of years of PTSD following trauma exposure at the population level.

(Skeffington, Rees, & Kane, 2013) and secondary prevention of PTSD (Birur, Moore, & Davis, 2017) and other stressor-related mental health issues. Such interventions might allow those at risk for developing PTSD (Brewin, Andrews, & Valentine, 2000; Kessler et al., 2017) and other trauma or stressor-related disorders to modify their dysfunctional coping strategies in an adaptive way.

The ability to 'bounce back' after facing trauma or adversity is the core focus of research into resilience. The word 'resilience' originates from the Latin verb '*resilire'*, which according to the Oxford Latin Dictionary translates into 'spring back' or 'rebound' (Glare, 2012). *Resilience* is not limited to traumatic experiences and is defined as "[t]he quality or fact of being able to recover quickly or easily from, or resist being affected by, a misfortune, shock, illness, etc.; robustness; adaptability" (Oxford English Dictionary, n.d.). Despite its etymological and linguistic definition, decades of research into resilience starting in the 1970s (Werner & Smith, 1979) have not led to a universal definition of psychological resilience, but resulted in a broad range of conceptualizations, which overlap and differ to varying extents (see Table 1).

Table 1. Definitions of resilience

Author(s)		Definition	Concept
Rutter	(1987)	Protective factors which modify, ameliorate or alter a person's response to some environmental hazard that predisposes to a maladaptive outcome. (p. 316)	trait
Masten, Best, & Garmezy	(1990)	The process of, capacity for, or outcome of successful adaptation despite challenging or threatening circumstances. (p. 426)	process
Luthar et al.	(2000)	A dynamic process encompassing positive adaptation within the context of significant adversity. (p. 543)	process
Masten	(2001)	A class of phenomena characterized by good outcomes in spite of serious threats to adaptation or development. (p. 228)	outcome
Connor & Davidson	(2003)	The personal qualities that enables one to thrive in the face of adversity. (p. 76)	trait
Bonanno	(2004)	The ability of adults in otherwise normal circumstances who are exposed to an isolated and potentially highly disruptive event such as the death of a close relation or a violent or life-threatening situation to maintain relatively stable, healthy levels of psychological and physical functioning, as well as the capacity for generative experiences and positive emotions. (p. 20-21)	trait

Table 1 (continued).

Agaibi & Wilson	(2005)	Complex repertoire of behavioral tendencies. (p. 197)	trait
Lee & Cranford	(2008)	The capacity of individuals to cope successfully with significant change, adversity or risk. (p. 213)	trait
Leipold & Greve	(2009)	An individual's stability or quick recovery (or even growth) under significant adverse conditions. (p. 41)	outcome
Feder, Nestler, & Charney	(2009)	Resilience refers to a person's ability to adapt successfully to acute stress, trauma or more chronic forms of adversity. A resilient individual has thus been tested by adversity and continues to demonstrate adaptive psychological and physiological stress responses, or 'psychobiological allostasis'. (p. 446)	trait/outcome
American Psychological Association	(2014)	Resilience is the process of adapting well in the face of adversity, trauma, tragedy, threats or significant sources of stress - such as family and relationship problems, serious health problems or workplace and financial stressors. It means 'bouncing back' from difficult experiences. (para. 2)	process
Hu, Zhang, & Wang	(2015)	[Resilience] describes the ability to bounce back from negative emotional experiences and flexibly adapt to the changing demands of stressful experiences. (p.18)	trait
Horn, Charney, & Feder	(2016)	Resilience is broadly defined as the ability to adapt successfully in the face of adversity, trauma, tragedy or significant threat. (p. 119)	trait

Note. Definitions of resilience adapted and amended from Fletcher and Sarkar (2013).

All definitions displayed in Table 1 include the response to a specific stressor. These stressors do not necessarily need to be traumatic but are described as adverse life events (including trauma, tragedy and any other significant threat) (Horn et al., 2016). Despite this consensus, the definitions vary in their precise conceptualization of resilience. Even though the list of definitions does not claim to be complete, it illustrates fundamental differences regarding the focus of the resilience concepts: resilience is conceptualized as an outcome, a trait variable, a process or a complex interplay of these aspects (Hu et al., 2015). Firstly, resilience can be defined as a personality trait that inoculates individuals against the negative impact of trauma and aversity (Connor & Davidson, 2003). So called trait-resilience is assessed using standardized self-report measures. Secondly, resilience can be conceptualized as an outcome, i.e.,

as the absence (or lower levels) of psychopathological symptoms after trauma and adversity (Bonanno, 2004). Thirdly, resilience can be described as an active and dynamic process of recovery after such life events. The latter conceptualization has been employed increasingly in recent research on trajectories of resilience (Galatzer-Levy, Huang, & Bonanno, 2018). These studies have aimed to apply the process-based approach using longitudinal symptom monitoring following adversity and identified resilience as the modal response (average of 66% across populations) to potentially traumatic events [for a review see Galatzer-Levy, Huang, and Bonanno (2018)]. Unfortunately, to date, only a few studies have combined trait-based and process-oriented approaches by assessing both trait variables and psychopathological symptoms over longer periods of time.

The theory of salutogenesis reflects a concept that is closely related to resilience and the understanding that resilience represents more than the mere absence of psychopathology (Almedom & Glandon, 2007). In contrast to resilience, which pertains to the response to a specific stressor, dealing with stressful or traumatic experiences constitutes only one case of application of the salutogenesis framework (Almedom, 2005). The concept of salutogenesis was coined by the medical sociologist Aaron Antonovsky (1979) and provides a theory focusing on the origins and maintenance of health rather than the causes of disease and risk factors contributing to psychopathology (Mittelmark et al., 2017). The core component and driving factor of the salutogenic framework is sense of coherence (SOC). According to Antonovsky (1979) SOC is shaped through life experiences and stabilizes as a function of age. Being faced with a stressor, a strong SOC enables an individual to mobilize resources relevant to adaptive coping processes. By means of this mechanism, SOC determines one's movement on the continuum between *ease* (health) and *dis-ease* (Mittelmark et al., 2017).

Upon comparison, resilience and salutogenesis differ with respect to their origins: while salutogenesis (1979) derived from research on health and stress, resilience research originates from studying risk and adversity (Eriksson & Lindström, 2011; Fossion et al., 2014). However, both concepts exhibit substantial conceptual and empirical overlap. The strongest may be the similarity between trait-resilience and SOC as health-promoting factors. Research into both resilience and salutogenesis emphasizes the relevance of resources - generalized (GRR) and specific resistance resources (SRR) - within the salutogenesis framework and protective factors in resilience research. Moreover, both concepts can be applied to individuals, groups (including family systems and communities), and societies. While the origin of salutogenesis is strongly linked to the conceptualization of health as an lifelong process of movement on a continuum, recent research on resilience focuses on trajectories (Galatzer-Levy et al., 2018) and thereby, increasingly develops into a similar direction. However, stressors are still the starting point of these trajectories. From a theoretical point of view, both salutogenesis and resilience research conceptualize responses to trauma and stressors as a process, which is supposed to be more than a correlate of a personality trait (i.e., trait-resilience or SOC) (Eriksson & Lindström, 2011). However, to date, in case of both concepts empirical research has only begun to mirror this process-oriented approach (Galatzer-Levy et al., 2018).

Correspondingly, examining research on exposure to trauma and adversity, studies predominantly demonstrated a strong bivariate and mostly cross-sectional association between posttraumatic stress symptoms and/or general mental health problems and both, trait-resilience (Blackburn & Owens, 2016; Burnett & Helm, 2013) and SOC (Ferrajão & Oliveira, 2016; Frommberger et al., 1999; Streb, Häller, & Michael, 2014). Higher levels of trait-resilience and a stronger SOC are consistently associated with less severe posttraumatic stress symptoms and fewer mental health problems. However, these studies are not able to reflect the presumed active coping processes that could be explained within the different frameworks. Scarce longitudinal research on both concepts demonstrated that pre-trauma SOC (Engelhard, van den Hout, & Vlaeyen, 2003) as well as trait-resilience assessed shortly after trauma (Daniels et al., 2012) were able to predict posttraumatic responses. Irrespective of these findings, studies that contrast both approaches using large-scale longitudinal data are missing, limiting the evidence base for conceptual comparison.

Furthermore, not only conceptual overlaps between resilience and salutogenesis negatively affect the clarity of research findings on health-benefitting correlates of successful coping. There are other concepts that may exhibit even stronger similarities and/or redundancies (e.g., Almedom, 2005; Grevenstein, Aguilar-Raab, Schweitzer, & Bluemke, 2016; Mittelmark et al., 2017). These are hardiness (Kobasa, 1979) [sometimes assessed as a sub-dimension of trait-resilience or synonym of trait-resilience as in the Dispositional Resilience Scale (Bartone, 2007)], locus of control (Rotter, 1966), self-efficacy (Bandura, 1977), sense of mastery (Pearlin & Schooler, 1978), and dispositional optimism (Scheier & Carver, 1987). Openness to experience as part of the 'Big Five' model of personality (Costa & McCrae, 1992) is occasionally also discussed as a health-benefitting factor - especially in the context of research on posttraumatic growth (DeViva et al., 2016; Schubert, Schmidt, & Rosner, 2016; Tedeschi & Calhoun, 1996) (see Figure 1).
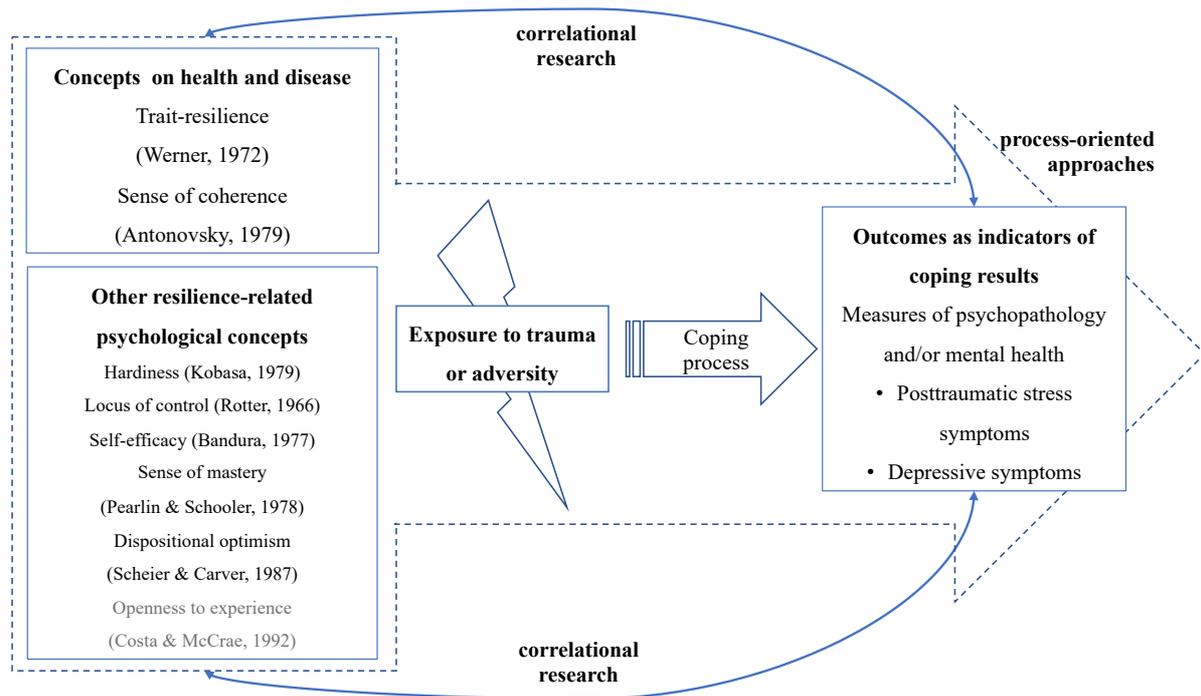
Figure 1. Illustration of different health-benefitting correlates of coping processes that are relevant to this thesis.

The theoretical framework of salutogenesis has been characterized as the most comprehensive approach to the development and maintenance of health in the face of various stressors (Agaibi & Wilson, 2005; Eriksson & Lindström, 2011). Moreover, SOC as its key component exhibits a particularly strong relationship with PTSD symptoms (Ferrajão & Oliveira, 2016) and mental health in general (Eriksson & Lindström, 2006; Suominen, Blomberc, Helenius, & Koskenvuo, 1999).

The following sections serve as a review of the theoretical and empirical background of this thesis. Beginning with an introduction of the salutogenesis framework, the role of SOC as its key component, and SOC's relationship with PTSD symptoms and general mental health based on cross-sectional and longitudinal findings. The second part will describe SOC's relationship with all other health-benefitting factors relevant to this thesis on a conceptual and empirical level. Thereafter, one paragraph will integrate these findings of different concepts and summarize conceptual overlaps. The section will close by describing current gaps in research and by outlining the aim of the present dissertation project.

2 THE CONCEPT OF SALUTOGENESIS

The made-up word '*salutogenesis*', coined by Aaron Antonovsky (1979), originates from the Latin term '*salus*', meaning 'health' (Glare, 2012) and the Greek word '*genesis*', which can be translated as 'origin' (Liddell & Scott, 1968). Thus, salutogenesis represents a theory on the development (and maintenance) of health contrasting with theories on pathogenesis (Mittelmark et al., 2017). According to the concept of salutogenesis, both health (*ease*) and illness (*dis-ease*) are poles on a continuum representing the enduring process of developing and maintaining health or disease. Thereby, *ease* as conceptualized by Antonovsky does not represent the absence of a specific set of diseases but reflects a holistic biopsychosocial state of health (Singer & Brähler, 2007), as defined by the WHO (1948) (Grad, 2002). However, despite this broad theoretical conceptualization of health, Antonovsky's work mainly concentrated on mental health (Antonovsky, 1985), which also influenced later research on salutogenesis (Eriksson & Lindström, 2006). Research on the theory of salutogenesis and physical health is less frequent and conclusive[2].

2.1 THEORETICAL ASSUMPTIONS

The theoretical framework of salutogenesis originates from Antonovsky's sociological research on stress (Mittelmark et al., 2017). According to the salutogenesis model, it is the norm rather than the exception that individuals are exposed to several stressors throughout their lifetimes (Antonovsky, 1979, 1987) (for a graphical illustration of the model see Figure 2). These stressors provoke a state of tension within the individual that can either be perceived as stress exerting pathogenic influence or be managed in a beneficial way. One's management of tension depends on individual resources and previous experiences. The salutogenesis framework proposes that individuals use and develop generalized resistance resources (GRR) against their sociocultural and historical background. Such GRRs are physical, biochemical, cognitive, emotional, interpersonal, and macro-social characteristics of individuals (or social systems) that support the process of dealing with different types of stressors.

Some of these GRR result from experiences during early years of life, e.g., parenting style, well-accepted social rules as well as individual characteristics such as temperament or personality traits. Moreover, genetic influences and one's physical condition also contribute to GRR. By making use of GRR the impact of stressors can be reduced, potential stressors can be avoided, and individuals may also be able to profit from the successful management of stressful experiences in terms of personal 'growth' (Singer & Brähler, 2007). This would further result in a strengthening of SOC.

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[2] SOC has also been shown to be predictive of physical health (Surtees, Wainwright, Luben, Khaw, & Day, 2006). However, its association with physical health is weaker and less consistently found (Eriksson & Lindström, 2006). Since none of the studies of this dissertation assesses physical health, a summary of SOC's relationship with physical health can be read in Flensborg-Matsen et al. (2005).

However, what are the factors that determine the use of resources and subsequent coping processes? According to the salutogenesis framework, SOC, as an intraindividual characteristic, modulates responses to stressors (Mittelmark et al., 2017). During early life, the frequent exposure to various stressors causes a state of chaos provoking intraindividual conflicts and tension. Motivated by this state of tension, individuals develop the ability to structure occurring stressors by identifying redundancies, which in turn will reduce the perceived level of chaos. In the course of this process, individuals are able to build an enduring confidence in their ability to be in control of their environment. The strength of this feeling determines one's level of SOC, particularly its *comprehensiveness* and *manageability* components (see chapter 2.2 for details on the role of SOC in the salutogenesis framework). Notably, the feeling of control in the salutogenesis theory is not tied or limited to individual control, but to the perception that the environment is controllable. However, control may also be executed by (well-meaning) others like spiritual entities (Antonovsky, 1996).

Multiple factors are relevant to the development of SOC. According to Antonovsky (1979, 1987), SOC as a global orientation is shaped by the sum of single experiences that allow for the perception of control over relevant outcomes. However, such experiences are dependent on the availability and use of sufficient GRR (e.g., material resources, intelligence, and social support). Thus, these manifest resources and SOC as a global orientation exhibit a reciprocal dynamic relationship: SOC is developed based on the availability and use of GRR and GRR are mobilized to deal with stressors through the use of SOC. Correspondingly, individuals who have access to stable and sufficient GRR, resulting from living in a stable personal and societal environment, will develop a stronger SOC, which in turn, will allow them to make use of these GRR and to acquire further resources (Singer & Brähler, 2007).

According to Antonovsky (1979, 1987) SOC will stabilize as a function of age and thereby allow for robust coping competencies. In the presence of stressors, individuals with a strong SOC will mobilize adequate resources to manage the state of tension evoked by the stressor. In this context, resources are also characterized as specific resistance resources (SRR)[3]. In case of a successful management of the stressor by the use of (G)RR - that is the reduction of tension -, individuals will move towards the end of *ease* on the continuum between *ease* and *dis-ease*. In contrast, when SOC does not allow for the mobilization of suitable and sufficient (G)RR and the management of the stressor fails, the individual will move in the direction of *dis-ease*.

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[3] Antonovsky initially differentiated generalized (e.g., self-esteem, self-regulation competences) and specific resistance resources (e.g., clinical supervision, staff support systems). Neither Antonovsky nor the ensuing salutogenic research focused much on their precise distinction. Therefore, the current dissertation refrained from differentiate between them. If both generalized and specific resistance resources are addressed, this is highlighted by using the abbreviation (G)RR.
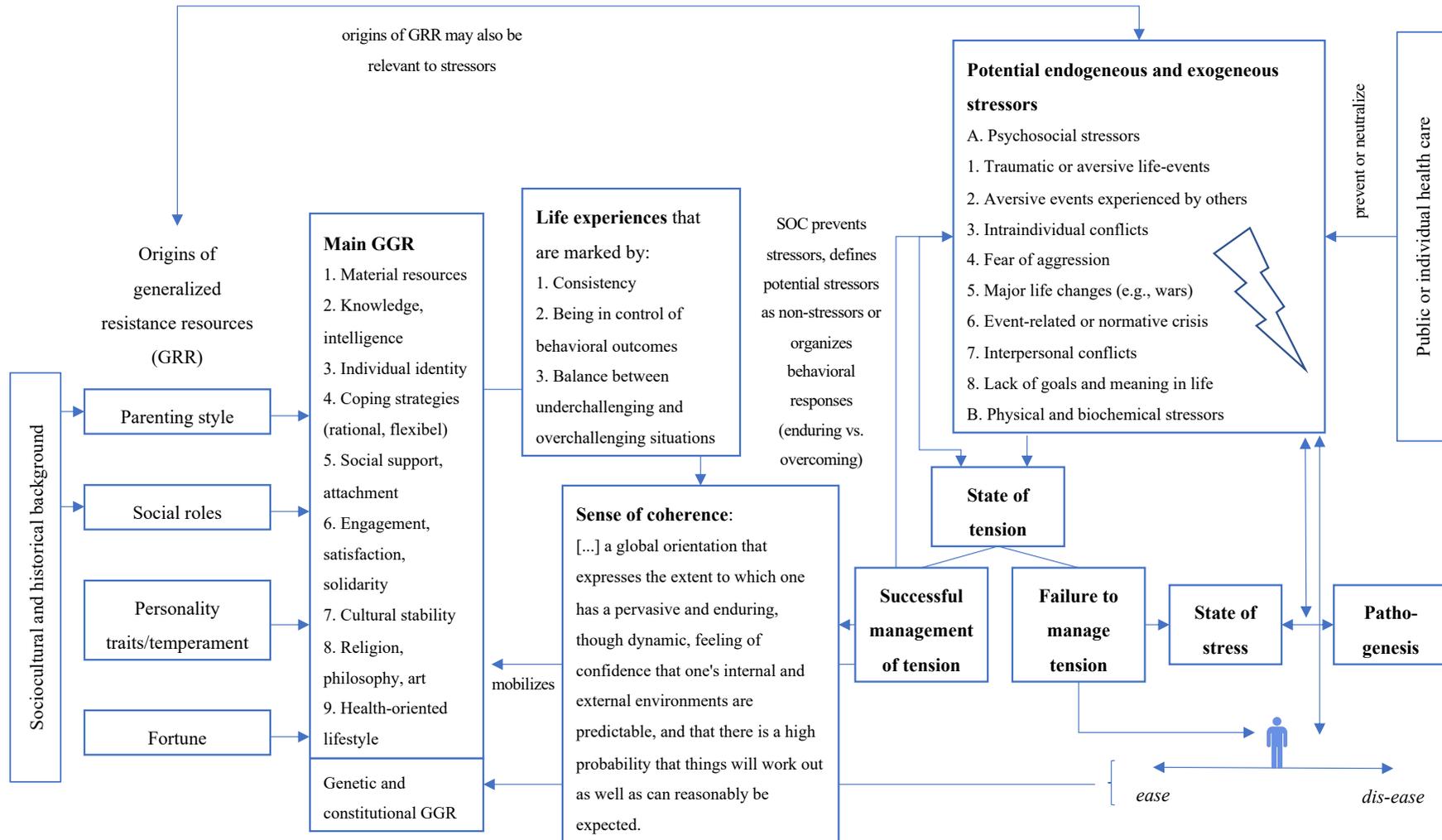
Figure 2. Illustration of the salutogenesis framework adapted and amended from Singer and Brähler (2007) as well as Antonovsky (1979).

2.2 THE ROLE OF SENSE OF COHERENCE

Sense of coherence is the core component of salutogenesis, which modulates the process of stressor management. Antonovsky's definition of SOC developed over time mainly through the addition of a spiritual component (i.e., *meaningfulness*). In his initial introduction to the framework of salutogenesis, he defined SOC as "a global orientation that expresses the extent to which one has a pervasive, enduring though dynamic, feeling of confidence that one's internal and external environments are predictable and that there is a high probability that things will work out as well as can reasonably be expected" (Antonovsky, 1979, p. 123). This definition was amended in his later work by the introduction of three components of SOC: "[...] feeling of confidence that (a) the stimuli deriving from one's internal and external environments in the course of living are structured, predictable and explicable; (b) the resources are available to her/him to meet the demands posed by these stimuli; and (c) these demands are challenges, worthy of investment and engagement" (Antonovsky, 1985, p. 276).

Drawing on these definitions, SOC comprises three interrelated components: (1) *Comprehensibility*: an individual's ability to make cognitive sense of life events, and understand internal and external experiences as structured, predictable, and logically consistent. (2) *Manageability*: an individual's perception of having the necessary personal and social resources to cope with life's demands and stressors, and the subjective expectation that one will be able to overcome adversity by using these resources. (3) *Meaningfulness*: an individual's belief that the demands of life are worth the cognitive and emotional investment and commitment, leading to experienced purpose in the challenges he/she encounter, and providing sufficient motivation.

Antonovsky characterized SOC as a "way of looking at the world" (Antonovsky, 1987, p. 8). Thus, SOC developed as a sociological rather than a psychological construct, is conceptualized as a fundamental belief or attitude that is supposed to influence one's view of the world. However, comparing the concept of SOC to other psychological concepts such as personality traits or state variables, it is still debated if SOC constitutes a stable and unchangeable disposition, a trait variable allowing for development or an interrelated set of beliefs relevant to coping processes (Feldt, Metsäpelto, Kinnunen, & Pulkkinen, 2007; Geyer, 1997). To date, this debate has not been solved and closely relates to the conceptual criticism of SOC (Bachem & Maercker, 2016).

2.2.1 CONCEPTUAL CRITICISM

Irrespective of its strong empirical relationship with different aspects of mental health (Eriksson & Lindström, 2006), there remains continuing controversy concerning the theoretical foundation of the SOC concept within the salutogenesis framework. This debate mainly centers on four aspects of SOC: SOC's temporal stability, its cross-cultural and social generalizability, the incremental validity of SOC beyond other health-benefitting concepts such as trait-resilience, sense of mastery or dispositional

optimism, and the psychometric assessment of SOC using the Antonovsky scales (Bachem & Maercker, 2016).

Firstly, SOC as defined by Antonovsky (1979, 1987) constitutes a stable disposition. Specifically, early life experiences during childhood and adolescence (see chapters 2.1 and 2.2) are assumed to contribute critically to the development of SOC. Accordingly, an individual's SOC should be fully developed around the age of 30, representing a relatively stable dispositional orientation (Antonovsky, 1979, 1987; Feldt et al., 2007). In line with this, studies demonstrated high test-retest stabilities for SOC in adult samples (Feldt, Leskinen, Kinnunen, & Mauno, 2000; Kivimäki, Feldt, Vahtera, & Nurmi, 2000; Schnyder, Büchi, Sensky, & Klaghofer, 2000). For example, Schnyder et al. (2000) reported test-retest stabilities ranging from $r_{tt} = .70$ to $r_{tt} = .77$ in an adult sample of accident victims ($N = 96$), who were assessed at three time points within one year (at time of trauma, after six and 12 months). Moreover, in line with Antonovsky's (1979, 1987) idea of a SOC that stabilizes as a function of age, a population-based study reported test-retest stabilities over a follow-up period of five years that were significant[4] lower in those younger than 30 years compared to those over the age of 30 ($r_{tt} = .70$ in younger adults vs. $r_{tt} = .81$ in older adults) (Feldt et al., 2006). During the five-year study period, SOC levels increased in both groups, but to a stronger extent in the younger subsample. However, other studies demonstrated substantial changes of SOC extending to older populations (P. M. Smith, Breslin, & Beaton, 2003). Contrary to Antonovsky's (1979, 1987) assumptions on temporal stability, drawing on a population-based sample that was studied over a period of five years, Nilsson et al. (2003) found the strongest decrease in SOC levels in the oldest age group (45 to 74 years). Other studies also demonstrated that negative life events impacted on SOC levels at various ages (Caap-Ahlgren & Dehlin, 2004; Snekkevik, Anke, Stanghelle, & Fugl-Meyer, 2003; Volanen, Suominen, Lahelma, Koskenvuo, & Silventoinen, 2007) and that interventions may impact on SOC levels even in older samples (Ando, Natsume, Kukihara, Shibata, & Ito, 2011; Lundqvist, Svedin, Hansson, & Broman, 2006).

Secondly, concerns have also been raised regarding the generalizability of salutogenesis and SOC across cultures and social (or socioeconomical) classes. Initially, SOC was conceptualized to be "universally meaningful […], cutting across lines of gender, social class, religion and culture" (Antonovsky, 1987) [for a detailed synthesis of the role of culture in salutogenesis, see Benz et al. (2014)]. However, in Antonovsky's later work (1998), it is acknowledged that SOC is likely to vary between different social groups. Indeed, differences in SOC have been described between genders, cultures, and social classes (Mittelmark et al., 2017). Studies indicated that SOC levels were higher in men compared to women [(Faresjö, Karalis, Prinsback, Kroon, and Lionis (2009); Moksnes, Espnes, and Lillefjell (2012); Nilsson, Leppert, Simonsson, and Starrin, (2010), but see: Nilsson, Holmgren, and Westman (2000)]. With respect to culture, some studies reported cultural differences for example

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[4] A post-hoc two-sided z-test for independent correlations conducted by the author of this thesis did reveal a significant difference, $z = 15.36$, $p < .001$.

between Swedish and Cretin populations as well as between a Turkish and a German sample [Erim et al. (2011); Faresjö, Karalis, Prinsback, Kroon, and Lionis, (2009); but see: Bowman, (1997)]. Furthermore, differences were also found within one country at one point of time: Walsh et al. (2014) found different SOC levels among cities in in the United Kingdom, whereby SOC levels were higher in Glasgow compared to Liverpool and Manchester. Moreover, regarding socioeconomic influences, Sagy and Antonovsky (2000) found that higher levels of family education and a higher socioeconomical status in childhood were related to a stronger SOC in later life. This is partly in line with findings from a Swedish sample (Lundberg, 1997), reporting no global differences between social classes, but children of skilled workers being at risk for low levels of SOC in adult life.

Thirdly, a large range of studies demonstrated a strong cross-sectional relationship between SOC and measures of mental health (Eriksson & Lindström, 2006; Mittelmark et al., 2017) or concepts associated with mental health (e.g., neuroticism). For example, in a student sample (M_{age} = 22) Kövi et al. (2017) reported a strong cross-sectional relationship (r = -.62) between SOC and depression. Moreover, Feldt et al. (2007) found a strong negative correlation (r = -.77) between SOC and neuroticism in an adult sample (M_{age} = 42). These strong relationships have been framed as both an argument supporting the external validity of SOC (Eriksson & Lindström, 2006) and as evidence questioning SOC's role as a unique construct. Some authors argue that SOC might simply represent an inverse measure of psychopathology lacking any incremental validity (Bachem & Maercker, 2016; Geyer, 1997). However, this criticism is challenged by studies showing SOC's strong predictive value for sickness absence in women over three years (Kivimäki et al., 2000) or subjective perceived general health over four years (Suominen, Helenius, Blomberg, Uutela, & Koskenvuo, 2001) even after controlling for baseline health measures. Consonantly, studies investigating SOC and other health-benefitting factors such as trait-resilience or self-efficacy generally do not support the notion of SOC being redundant (Almedom, 2005). Conversely, these studies mainly showed SOC's incremental association with measures of psychopathology that exceeded those with other health-benefitting factors, for example contrasted with trait-resilience in a sample of paramedics (Streb et al., 2014) or compared to trait-resilience, self-compassion, and dispositional optimism in a student sample (Grevenstein, Aguilar-Raab, et al., 2016).

Fourthly, almost all studies investigating SOC used the scales developed by Antonovsky (1993) either in their short 13-item or in their long 29-item version. However, these scales have been criticized due to their insufficient psychometric qualities. Particularly the three-factor structure consisting of *comprehensibility*, *manageability* and *meaningfulness* proposed by Antonovsky (1993) could not be replicated (Frenz, Carey, & Jorgensen, 1993). Notably, Frenz et al. (1993) used an exploratory factor analysis to replicate the structure proposed by Antonovsky (1993), although confirmatory factor analysis (CFA) or exploratory structural equation modeling would have been more appropriate from a methodological point of view (Asparouhov & Muthén, 2009). In support of the proposed factorial structure of the SOC scales, more recent research using structural equation modelling generally replicated Antonovsky's (1993) three subscales, although one also identified a second-order factor

(Feldt et al., 2006), while another study in adolescents using CFA only identified two factors [*comprehensibility*/*manageability* (factor 1) and *meaningfulness* (factor 2)] (Zimprich, Allemand, & Hornung, 2006). To overcome this criticism, Bachem and Maercker (2016) developed a new scale to assess SOC: SOC-Revised (SOC-R). SOC-R is supposed to capture the concept of SOC more precisely in terms of item content and to exhibit a superior factorial structure compared to the Antonovsky scales (1993). However, due to its recent development, the new SOC-R scale has been less extensively used in research (Mc Gee, Höltge, Maercker, & Thoma, 2017, 2018). Current results indicate a stable relationship with mental health as measured by the Patient-Health Questionnaire (Martin, Rief, Klaiberg, & Braehler, 2006) in a representative German sample (Thoma, Mc Gee, Fegert, Glaesmer, & Maercker, 2017). However, comparing these relationships ($r = -.10$ between SOC-R and the total burden on mental health) to those reported for the Antonovsky scales (1993), the associations seem to be smaller[5]. This notion is also supported by a recent study investigating the relationship between SOC-R and posttraumatic stress symptoms in rescue workers which reported a bivariate relationship of $r = -.11$ between SOC-R and PTSD symptoms (Behnke, Conrad, Kolassa, & Rojas, 2019). Moreover, existing studies showed that particularly the *meaningfulness* subscale of SOC-R exhibited a substantial relationship with mental health (Behnke et al., 2019; Mc Gee et al., 2018). Thus, future research using appropriate factor analysis methods [i.e., exploratory structural equation modeling (Marsh, Morin, Parker, & Kaur, 2014)] has to show if SOC-R genuinely represents a better SOC assessment reflected in better psychometric properties and if its proposed subscales (*meaningfulness*, *reflection*, and *balance*) are all relevant to mental health or if this relationship is predominantly evident for the *meaningfulness* subscale which may exhibit the strongest overlap with the Antonovsky scales (1993).

2.3 The Relationship between Sense of Coherence and Mental Health

Despite the described criticism of the SOC concept, various studies demonstrated its strong relationship with health, particularly mental health (Eriksson & Lindström, 2006). Consonantly, higher levels of SOC are associated with lower levels of psychopathological symptoms (i.e., general mental health problems, depressive and anxiety symptoms, and PTSD symptoms). This relationship has been demonstrated in both cross-sectional and longitudinal studies and corresponds to Antonovsky's theory

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[5] This notion of a stronger association with mental health outcomes for the original Antonovsky scales (1993) is further supported by the comparison of the relationships between SOC-R total scores and mental health with those of the Antonovsky scales in the initial publication on the revised SOC scales (Bachem & Maercker, 2016). A post-hoc two-sided z-test for dependent correlations conducted by the author of this thesis revealed significant differences for both samples of the SOC-R validation study, Sample 1: $z = 5.15$, $p < .001$; Sample 2: $z = 6.25$, $p < .001$. In both samples, associations of SOC total scores and mental health were significantly stronger for the Antonovsky scales (1993) compared to the revised version by Bachem and Maercker (2016).

(1979, 1987) on salutogenesis and SOC and its proposed impact on the development and maintenance of (mental) health.

2.3.1 THEORETICAL CONSIDERATIONS

Based on Antonovsky's salutogenesis framework (1979, 1987) SOC influences mental health via multiple mechanisms. Higher levels of SOC are assumed to lead to a stronger engagement in health-promoting activities (Mittelmark et al., 2017), which in turn support the development and maintenance of mental health. Moreover, SOC is supposed to influence the classification of internal and external events as stressors or non-stressors. Furthermore, through its *comprehensibility* component SOC influences whether a stressor is perceived as structured and ordered or chaotic. Following the classification of an event or situation as stressful, SOC is supposed to enable an individual to make flexible use of internal and external resources [(G)RR] that are relevant to the specific stressor. Subsequent to a behavioral response to a specific stressor, SOC initiates the evaluation of the preceding behavior and allows for behavioral adaption processes if necessary. Moreover, SOC is believed to initiate coping processes not only on a behavioral but also on an emotional level. By enabling an individual to cope with various stressors in a beneficial way, in turn, SOC levels remain stable or increase in terms of perceived personal 'growth' (Mittelmark et al., 2017). However, this concept of 'growth' is not further elaborated within the salutogenesis theory. Thus, the overlap with the concept of posttraumatic growth (Tedeschi & Calhoun, 1996) remains unclear.

As evident from these assumptions, Antonovsky's concept of salutogenesis (1979, 1987) provides a comprehensive theoretical base for SOC's dynamic modulating relationship with mental health. However, most of these assumptions are related to intraindividual processes (i.e., the perception of the nature of stressors), which complicates and limits the opportunity for empirical testing. Moreover, the theory is at least partially tautological: the perception of a stressor as structured and ordered is reflective of high levels of SOC (Antonovsky, 1993) and at the same time, high levels of SOC causally result in perceiving stressors as structured and ordered (Mittelmark et al., 2017).

Hence, even being grounded in Antonovsky's theory (1979, 1987) of salutogenesis, research on SOC's relationship with mental health was hardly able to test process-related hypotheses of SOC's influence on mental health. Such research would allow to study the processes and mechanisms (e.g., mobilizing multiple resources) by which SOC is supposed to impact on mental health over longer periods of time. Only large-scale longitudinal research into trajectories of SOC and psychopathology across the lifespan including a comprehensive assessment of coping resources would enable the investigation of SOC's functional role as conceptualized within the salutogenesis framework.

2.3.2 EMPIRICAL EVIDENCE

Given the lack of such process-related studies, our current understanding of SOC bases mainly on investigations of SOC's cross-sectional and longitudinal relationship with measures of mental health.

Due to their particular relevance to this thesis, the following paragraphs will focus on SOC's relationship with general mental health problems and posttraumatic stress symptoms as the main outcomes of the studies included in this thesis. For a detailed overview of its association with specific other mental health issues such as symptoms of depression or burnout, see Eriksson and Lindström (2006). Moreover, SOC's association with quality of life, which can be considered as an inverse indicator of health problems, is reviewed in Eriksson and Lindström (2007).

2.3.2.1 CROSS-SECTIONAL EVIDENCE

Many cross-sectional studies investigated the association between SOC levels and different aspects of mental health including general mental health problems and PTSD symptoms. In line with Antonovsky's theoretical assumptions (1979, 1987), higher levels of SOC are consistently associated with lower levels of both general mental health problems as well as posttraumatic stress symptoms. For example, Li et al. (2015) found a strong negative association between SOC levels and general mental health problems (i.e., total burden caused by psychopathological symptoms) in a sample of 468 Chinese hospital patients. Moreover, SOC was found to be positively correlated with subjectively perceived mental health ($r = .66$). Overall, SOC's negative relationship with mental health problems was consistently found across various cultures, including Finnish (Suominen et al., 1999), Swedish (Larsson & Kallenberg, 1996; K. W. Nilsson et al., 2010), Japanese (Urakawa & Yokoyama, 2009), South African (Van der Colff & Rothmann, 2009), Belgian (Fossion et al., 2014), and German samples (Frommberger et al., 1999). It has also been demonstrated in the general population (Nilsson et al., 2003), in student samples (Grevenstein, Aguilar-Raab, et al., 2016), and in different patient populations (Li et al., 2015; Tagay, Herpertz, Langkafel, & Senf, 2005).

These studies provide strong support for a robust association between SOC - as measured by the Antonovsky scales (1993) - and psychopathological symptoms if both are assessed at the same time (or following a stressful or traumatic life event). However, these studies fail to answer the question whether pre-stressor SOC levels enable successful coping processes or if the association between low SOC levels and high levels of psychopathological symptoms may result from the conceptual overlap between SOC and psychopathological symptom measures. Moreover, it is also plausible to assume that SOC may be negatively impacted by current mental health problems.

2.3.2.2 LONGITUDINAL EVIDENCE

To answer these questions, longitudinal studies into SOC and its relationship with mental health are of particular relevance. In this regard, large-scale longitudinal studies were able to demonstrate SOC's ability to predict mental health problems in the general population. For example, Kouvonen et al. (2010) investigated a sample of Finnish employees whose SOC levels were measured 1986. After 19 years, psychiatric diagnoses made in hospitals, suicide attempts, and suicides were assessed based on official national registers. Even after controlling for baseline psychopathological symptoms, SOC levels were

significantly predictive of psychiatric diagnoses, suicide attempts, and suicides. A strong SOC was associated with a 40% decreased risk to be hospitalized due to a psychiatric disorder, make a suicide attempt, and to complete suicide. These findings are particularly relevant from a conceptual point of view, since they demonstrate that SOC levels assessed at one time do not only reflect impeded mental health. If this had been the case, controlling for baseline psychopathological symptom levels would have diminished SOC's predictive value.

Similarly, Grevenstein et al. (2016) contrasted the predictive validity of SOC, neuroticism, extraversion, and self-efficacy in a sample of adolescents. According to Antonovsky's theory (1979, 1987) SOC should be less stable in adolescence. Nonetheless, SOC demonstrated incremental validity above the other variables, and predicted substance abuse after nine years as well as mental health after one and four years. Again, these findings remained significant after controlling for baseline psychopathology, further challenging the conceptual criticism of SOC.

With respect to posttraumatic stress symptoms, to the best of my knowledge, only one study exists that investigated pre-trauma SOC levels as a predictor of posttraumatic responses. Engelhard et al. (2003) reported findings of a longitudinal study on pregnant women whose SOC levels were assessed in early pregnancy. Of the 1,372 women initially assessed, 126 experienced a traumatic pregnancy loss ($N = 118$ due to dropout). Initial SOC levels (assessed around eight weeks of pregnancy) were predictive of posttraumatic stress symptoms one month after pregnancy loss and accounted for 6% of their variance. SOC's predictive value was also evident for depressive symptoms, even after controlling for baseline depression levels. Interestingly, the relationship between SOC and PTSD symptoms was mediated by the use of crisis support following loss. This is in line with Antonovsky's theory of SOC initiating the mobilization of (G)RR to allow for successful coping processes. However, the aforementioned findings need to be interpreted with caution since PTSD symptom levels and crisis support were both assessed at the same time using self-report measures, which might have confounded the association.

While further longitudinal studies exist (Schütte, Bär, Weiss, & Heuft, 2012; Tham, Christensson, & Lena Ryding, 2007), these studies only assessed SOC levels immediately after the potentially traumatic event rather than pre-trauma. Although these studies provide additional evidence of SOC's ability to predict PTSD symptoms over a longer period of time, they are not able to differentiate between the predictive value of pre-trauma SOC levels and the potential impact of traumatic events on SOC. This limitation is particularly relevant since SOC levels have been shown to be negatively affected by major life events (Volanen et al., 2007). Furthermore, the relationship between SOC and PTSD symptoms has also been discussed against the background of the shattered assumptions approach (Janoff-Bulman, 1989; Kaźmierczak, Strelau, & Zawadzki, 2016). According to this approach traumatic experiences - in particular man-made disasters - may lead to a fundamental erosion of basic assumptions, which could, in turn, also negatively impact on SOC levels.

Thus, although effortful, longitudinal research on SOC's relationship with mental health is needed. With respect to general mental health, research may shed light on the process-related and dynamic impact of SOC on mental health as claimed by the salutogenesis theory. Regarding posttraumatic stress symptoms, there is a substantial lack of studies that assess pre-trauma SOC levels and PTSD symptoms over a longer time post-trauma. Ideally, these studies would also allow for conclusions on a process-related and dynamic level by investigating proposed mediating and moderating variables, i.e., the use of (G)RR.

2.4 THE RELATIONSHIP BETWEEN SENSE OF COHERENCE AND OTHER HEALTH-BENEFITTING FACTORS

Even though some studies demonstrated SOC's incremental validity above other health-benefitting factors (Grevenstein, Aguilar-Raab, et al., 2016; Grevenstein, Bluemke, et al., 2016; Streb et al., 2014), these findings do not account for or 'resolve' the conceptual overlap between SOC and these factors on a theoretical level.

On the contrary, SOC's strong association with mental health outcomes may actually result from its overlap with various health-benefitting factors, which in turn may suggest that SOC represents a culmination of these factors. However, despite strong evidence for a conceptual overlap between SOC and other health-benefitting factors, there is little qualitative and quantitative research investigating the specifics of these relationships (i.e., investigate more than two concepts at a time or addressing overlaps based on specific items). Factors that have been discussed as potentially overlapping are trait-resilience (Connor & Davidson, 2003; Werner & Smith, 1979), locus of control (Rotter, 1966), self-efficacy (Bandura, 1977), hardiness (Kobasa, 1979), sense of mastery (Pearlin & Schooler, 1978), dispositional optimism (Scheier & Carver, 1987), and openness to experience (Costa & McCrae, 1992).

Preparing this thesis, the lack of evidence on details of their potential overlap inspired an online survey on the associations between these concepts. Table 2 presents the Pearson correlations between the aforementioned health-benefitting factors and the 13 items of the SOC scale (Antonovksy, 1993), its subscales (*comprehensibility*, *manageability*, and *meaningfulness*) and its total score.

Table 2. Items of the 13-item version of the SOC scale, the SOC subscales as well as total SOC scores and their association with other health-benefitting factors assessed in a student sample ($N = 94$)

			Pearson correlations (r)								
				LOC							
Item	subscale		trait-resilience	internal	external	SE	hardi-ness	SOM	DO	OE	BSCL
1	ME	Do you have the feeling that you really don't care about what is going on around you?	.16	.19	.07	-.03	.34**	-.02	.06	.08	.06
2	CO	Has it happened in the past that you were surprised by the behavior of people whom you thought you knew well?	.12	.02	-.40**	-.06	.08	.29*	-.09	.00	-.10
3	MA	Has it happened that people whom you counted on disappointed you?	.30*	.07	-.40**	.16	.25*	.36**	-.14	-.14	.18
4	ME	Until now your life has had: no clear goals – very clear goals and purpose	.39**	.19	-.19	.28*	.30*	.19	.25*	-.08	-.13
5	MA	Do you have the feeling that you are being treated unfairly?	-.15	-.27*	.26*	-.19	-.33*	.34**	.04	-.24*	.20
6	CO	Do you have the feeling that you are in an unfamiliar situation and don't know what to do?	.47**	.37**	-.31*	.36**	.50	.45**	-.13	.25*	-.35*
7	ME	Doing the things you do every day is: a source of deep pleasure and satisfaction – a source of pain and boredom?	.48**	.41**	-.33*	.28*	-.51**	.45**	-.16	.24*	-.45**
8	CO	Do you have very mixed-up feelings and ideas?	.48**	.30*	-.32*	.33*	.44**	.66**	.42**	-.20*	-.62**
9	CO	Does it happen that you experience feelings that you would rather not have to endure?	.45**	.28*	-.36**	.31*	.48**	.67**	.43**	-.13	-.55**

Table 2 (continued).

10	MA	Many people, even those with a strong character, sometimes feel like losers in certain situations. How often have you felt this way in the past?	.45**	.32*	-.33*	.33*	.39*	.60*	.32*	-.02	-.51**
11	CO	When certain events occurred, have you generally found that you overestimated or underestimated their importance – you assessed the situation correctly?	.31*	.21*	-.23*	.18	.28*	.34**	.31*	-.11	-.30*
12	ME	How often do you have the feeling that there is little meaning in the things you do in your daily life?	.49**	.42**	-.39**	.38**	.56**	.57**	.43**	-.07	-.62**
13	MA	How often do you have the feeling that you are not sure you can keep under control?	.44**	.41**	-.39**	.40**	.51**	.75**	.52**	-.07	-.62**
		SOC – comprehensibility	.56**	.35**	-.49**	.33**	.54**	.73**	.42**	-.21*	-.60**
		SOC – manageability	.47**	.26*	-.40*	.32*	.39**	.66**	.36*	-.10	-.62**
		SOC – meaningfulness	.57**	.47**	-.33*	.34**	.66**	.48**	.39**	-.10	-.46**
		SOC total	.68**	.44**	-.52**	.41**	.67**	.80**	.49**	-.18	-.72**

Note. BSCL = Brief Symptom Checklist; CO = comprehensibility; DO = dispositional optimism; LOC = locus of control; MA = manageability; ME = meaningfulness; OE = openness to experience; SE = self-efficacy; SOC = sense of coherence; SOM = sense of mastery.

Measurements. SOC: Sense of Coherence Scale - 13 item version (Antonovsky, 1993; German: Brähler & Singer, 2007); trait-resilience: Resilience Scale 11 (RS-11; Wagnild & Young, 1993; German: Schumacher, Leppert, Gunzelmann, Strauss, & Brähler, 2005); LOC: Die Skala Internale-Externale-Kontrollüberzeugung-4 (IE-4); SE: Allgemeine Selbstwirksamkeit Kurzskala (ASKU; Beierlein, Kovalea, & Rammstedt, 2014); Hardiness: Dispositional Resilience Scale (Bartone, 1995; German version translated by the author of this thesis); SOM: Sense of Mastery Scale (Pearlin & Schooler, 1978; German: Rüsch, Bartlomé, & Huber, 2006); DO: Skala Optimismus-Pessimismus (SOP2; Kemper, Beierlein, Kovaleva, & Rammstedt, 2014); OE: NEO-FF-I (Costa & McCrae, 1992; German: Borkenau & Ostendorf, 2008); general mental health problems: Brief Symptom Checklist (BSCL; Franke, 2019).

* *p* < .05, ** *p* <.001.

See Appendix A for the complete correlation matrix including all concepts and their intercorrelations.

As evident from the correlations (see Table 2), there exists a substantial overlap between items of the SOC scale (Antonovsky, 1993), the SOC subscales, the SOC total scores and other health-benefitting factors. Except for openness to experience (r = -.18), all health-benefitting factors show a significant relationship with the SOC total score. The strongest overlap is evident between SOC and sense of mastery (r = .80), with SOC and sense of mastery scores sharing 64% of their variance. Consequently, the association between SOC and sense of mastery is also significantly stronger than the second largest correlation, between SOC and hardiness (z = 2.52, p = .006). This pattern of results also applies to the SOC subscales *comprehensibility* and *manageability*, where sense of mastery was the strongest and openness to experience the weakest correlate. Only in case of *meaningfulness*, the strongest correlation is evident with hardiness (r = .66). However, this association was not significantly stronger than *meaningfulness'* relationship with trait-resilience (r = .57; z = 1.5, p = .134). Strong correlations indicating substantial overlap are also evident on a single item level. For example, sense of mastery demonstrates strong associations with items of the *comprehensibility* subscale (r = .34 - .67) whilst showing its strongest correlation with an item of the *manageability* subscale (Item 13: "How often do you have the feeling that you are not sure you can keep under control?"; r = .75), effectively sharing 56% of their variance.

Overall, the online survey demonstrates a strong overlap between SOC and other health-benefitting factors (except for openness to experience). However, in a multiple regression model including all factors that exhibit a strong bivariate relationship ($r \leq$ -.50)[6] with general mental health, SOC, sense of mastery, trait-resilience and hardiness collectively account for 56% of the variance in general mental health problems [F(4,81) = 25.21, p < .001], but only SOC uniquely explained a significant amount of variance [β = -.45, t(81) = -3.18, p = .002]. Against the background of other studies demonstrating strong correlations between health-benefitting factors as well as SOC's role as the most important correlate (Grevenstein, Aguilar-Raab, et al., 2016; Grevenstein, Bluemke, et al., 2016; Streb et al., 2014), these findings raise the question, whether concepts such as trait-resilience are distinct from SOC on a theoretical and empirical level.

2.4.1 (TRAIT-)RESILIENCE

Beyond the general lack of studies comparing the influence of SOC and other health-benefitting factors, it is of note that most research has been conducted into the association between SOC and resilience. The overlap between SOC and resilience is most apparent when resilience is conceptualized as a personality trait, which is assessed using self-report instruments (Hu et al., 2015). Conversely, when resilience is defined as an outcome (i.e., the absence or low levels of psychopathology following adversity), SOC might be a factor that contributes to or results in this

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[6] Due to problems caused by a large number of predictors variables in multiple regression analyses (Algina & Olejnik, 2003), only the strongest bivariate correlates were included in the multiple regression analysis.

beneficial outcome, but which does not overlap with it (but see the conceptual criticism outlined in chapter 2.2.1). However, concerning trait-oriented research, there is a substantial theoretical and empirical overlap between SOC and trait-resilience. To date, a consensual definition of trait-resilience is missing. However, trait-resilience may be broadly defined as a set of intraindividual characteristics (i.e., protective factors) that enable an individual to successfully adapt to adversity (Lü, Wang, & You, 2016). Conversely, vulnerability is conceptualized as a set of intraindividual characteristics (i.e., risk factors) that put an individual at risk for failed coping processes, which may in turn result in the development of psychopathological symptoms. A meta-analysis showed that trait-resilience is robustly correlated with different mental health outcomes ($r = -.36$ for negative and $r = .50$ for positive indicators of mental health) (Hu et al., 2015).

From a theoretical perspective, the concepts of SOC and trait-resilience are both related to the use of coping resources in order to deal with stressors in an effective way (Eriksson & Lindström, 2011). However, while SOC as the key component of the salutogenesis model originates from sociological research on stress, trait-resilience derived from research on responses to adversity. Hence, as stated above, SOC and salutogenesis are assumed to represent a broader theoretical framework in comparison to different theories on trait-resilience (Almedom, 2005). With respect to resources, (G)RR in salutogenesis are similar to protective factors in resilience research (Eriksson & Lindström, 2011). Both (G)RR and protective factors are thought to enable better coping processes in the face of major life stressors. Moreover, similar to the theory of salutogenesis, the concept of resilience can also be applied to individuals, groups (including families), and societies. However, from a theoretical point of view, both concepts differ in their precise conceptualization of coping processes: while research on resilience characterizes coping processes as a balance of protective and risk factors influencing the development or absence of disease, the salutogenesis theory proposes that SOC moderates coping processes and modulates an individual's position on the continuum between *ease* and *dis-ease*. Thus, the theory of salutogenesis does not entail a concept of risk factors that exert pathogenic influences. In line with this, Lundman et al. (2010) argue that the concepts of resilience and salutogenesis (i.e., SOC) try to answer different questions. While the theory of salutogenesis aims to elucidate what facilitates individuals to move towards the end of *(dis-)ease*, the concept of resilience is focused on the ability of 'bouncing back' after a specific adverse or traumatic experience. Thereby, resilience and vulnerability are not conceptualized as two ends of a continuum modeling health in general, but as dispositions modulating responses to a particular stressor.

This notion of overlap but not redundancy is also supported by the few existing empirical studies on the relationship between SOC and trait-resilience: Fossion et al. (2014) aimed to differentiate both concepts in a sample of Jewish children (and a matched control group), who were hidden during World War II. They assessed symptoms of depression and anxiety, SOC and trait-resilience [measured using the Resilience Scale for Adults (Hjemdal, Friborg, Martinussen, & Rosenvinge, 2001)]. In a mediation model, childhood trauma was used as a predictor variable, adult trauma as a

moderator and SOC as a mediator, while depressive and anxiety symptoms functioned as outcomes. To differentiate between SOC and trait-resilience, the authors predicted SOC as a function of trait-resilience and thereby separated variances that were shared by both concepts from those that were unique to each predictor. In their mediation model both SOC's unique variance and the amount of shared variance with trait-resilience functioned as significant predictors of depression and anxiety symptoms. However, the unique amount of variance accounted for by SOC was no mediator and not related to lifetime trauma, while the variance shared with trait-resilience was related to early and later life trauma. Thus, the authors concluded that SOC may have two components: one that is similar to trait-resilience and functions as a disposition that is sensitive to life events and another one that represents a stable disposition not impacted by life events. Unfortunately, the authors did not include an analysis on the unique impact of trait-resilience when regressed onto SOC, which would have further elaborated their argument in favor of SOC's specific relevance.

Although other studies did not mainly focus on the comparison of SOC and trait-resilience and their unique impact on psychopathological symptoms, their findings are in line with the results of Fossion et al. (2014). For example, in a cross-sectional study of a large sample of 668 paramedics, Streb et al. (2014) found that SOC was the only significant predictor of PTSD symptoms when entered into a multiple regression together with trait-resilience [measured using the RS-11 (Schumacher, Leppert, Gunzelmann, Strauss, & Brähler, 2005), a short version of the Resilience Scale (Wagnild & Young, 1993)]. SOC uniquely accounted for 19% of the variance in PTSD symptoms while trait-resilience exhibited no significant predictive value for PTSD symptoms $(\Delta R^2 = .00)$. Correspondingly, Grevenstein et al. (2016) compared the association of SOC, trait-resilience [measured using the RS-13 (Leppert, Koch, Brähler, & Strauss, 2008), another short version of the Resilience Scale (Wagnild & Young, 1993)], dispositional optimism, and self-compassion with general mental health problems in two student samples. In both samples, SOC's predictive value exceeded those of all other health-benefitting factors, which did not show unique increments beyond SOC, challenging the relative importance of trait-resilience. These findings are also concordant with further studies on adolescents which demonstrated that trait-resilience did not have incremental validity concerning adaptive behaviors (i.e., global life satisfaction, quality of relationships, etc.) and beyond the 'Big Five' (Waaktaar & Torgersen, 2010). In case of SOC, this incremental validity beyond the 'Big Five' has been shown to predict mental health, life satisfaction, and individual distress (Grevenstein & Bluemke, 2015). From a content point of view, Grevenstein et al. (2016) argued that the assessment of SOC - in contrast to trait-resilience - comprises the relevant aspect of meaning in life. Even though the resilience scale by Wagnild and Young (1993) aims to assess an individual's perception of life as meaningful, the short version of the scale exhibits a two component structure of *personal competence* and *acceptance of self and life*. These components, particularly *acceptance of self and life*, may be related to *meaningfulness* as assessed by the SOC scales

(Antonovsky, 1993) but are not necessarily equivalent. However, studies on subscale levels that would provide further insight into the sources of SOC's incremental validity are missing.

An issue that further complicates the comparison of research findings on the association between SOC and trait-resilience is the heterogeneity of trait-resilience measures [e.g., the Connor-Davidson Resilience Scale (Connor & Davidson, 2003) or the Resilience Scale (Wagnild & Young, 1993)]. These instruments are similar and all aim to assess trait-resilience as one's ability to adapt well in the face of adversity. However, they vary in their specific conceptualizations of resilience and item details [for an overview of measures see Windle, Bennett and Noyes (2011)], resulting in different factor structures. As opposed to SOC, which originated from the salutogenesis framework and is most frequently assessed using the Antonovsky scales (1993), research into resilience is not linked to a specific theory or instrument. This may be considered as both, an advantage as well as a disadvantage: on the one hand, research findings on SOC might be limited and biased by psychometric problems of the Antonovsky scales (Bachem & Maercker, 2016). On the other hand, the usage of a single instrument ensures comparability across studies, which might be reduced in case of trait-resilience. Hence, findings on the relationship between SOC and trait-resilience and especially, qualitative analyses related to specific components of resilience [as discussed in Grevenstein et al. (2016)] always need to be interpreted against the background of the specific resilience measure and its factorial structure.

Overall, SOC and trait-resilience are related concepts that share a substantial amount of variance when used as predictors of general mental health problems and PTSD symptoms. Evidence concerning their unique impact is limited and needs to be further investigated. However, current findings suggest that SOC's relationship with mental health outcomes is stronger and that the key component of salutogenesis exhibits incremental validity beyond trait-resilience for both general mental health problems and PTSD symptoms (Fossion et al., 2014; Grevenstein, Aguilar-Raab, et al., 2016; Streb et al., 2014). Future studies have to confirm these preliminary inferences and should focus on the underlying differences in content of SOC's predictive value beyond trait-resilience.

2.4.2 Locus of Control

Another concept frequently studied as a health-benefitting factor is LOC (Rotter, 1966). LOC assesses the degree to which individuals have the impression that events and rewards are controllable by their own actions (internal LOC) or predominantly depend on factors beyond their personal influence (external LOC) (Lefcourt, 1976). Thereby, LOC has frequently been conceptualized as a unipolar construct reaching from an external to an internal pol. However, later research on LOC suggested that a two-dimensional structure (i.e., internality and externality as separate dimensions) seems to be more appropriate and to exhibit stronger predictive validity for relevant outcomes (Kovaleva, Beierlein, Kemper, & Rammstedt, 2012; Levenson, 1972). Research into LOC has shown that a stronger internal and a weaker external LOC are associated with better mental health (Gore,

Griffin, & McNierney, 2016). For instance, in a sample of nurses, an internal LOC has shown to be positively related to general mental health (Jennings, 1990). Moreover, a stronger internal LOC was found to be a significant predictor of trajectories of PTSD symptoms in a sample of Israeli soldiers (Karstoft, Armour, Elklit, & Solomon, 2015), where a stronger internal LOC was associated with a lower risk of developing symptoms of acute and chronic distress.

With respect to salutogenesis, only few studies have investigated the association between SOC and LOC. Existing research mainly originates from the field of organizational psychology and is thus not applicable to the association of both concepts with mental health outcomes.

Since the theory of LOC was already introduced in the 1960s by Rotter (1966), Antonovsky was aware and inspired by this approach and conceptualized SOC along with LOC, hardiness, self-efficacy and sense of mastery as "generalized personality orientation[s]" (Antonovsky, 1991, p. 70), which enable the development of *ease* as salutogenic strengths[7]. From a theoretical perspective, the strongest association between SOC and LOC is assumed to exist between LOC and the SOC component *manageability*, which was developed by Antonovsky inspired by the LOC theory (Mittelmark et al., 2017). *Manageability* is defined as an individual's perception of being in possession of personal and social resources [i.e., (G)RR] to cope with life stressors and the subjective expectation that these resources will allow for successful coping. While the latter shows a stronger association with self-efficacy and dispositional optimism (see below), the former may show some overlap with LOC. However, while the SOC concept stresses the perception of resources (being internal or external) to initiate successful coping processes, the concept of LOC concentrates on behavioral control over these processes (and one's actions in general). Thus, having an internal LOC is not related to the possession of specific resources and the expectation of a beneficial outcome, but describes the assumption that potential outcomes could be controlled by oneself (Sullivan, 1993). Moreover, other authors also suggested the SOC component *comprehensibility* to be the main link between SOC and LOC (Santavirta et al., 1996). *Comprehensibility* is characterized as an individual's ability to make cognitive sense of life events and to perceive experiences - may they be internal or external - as structured, predictable, and logically consistent. While the extent of an internal and external LOC may also be correlated with *comprehensibility* scores, especially given the substantial intercorrelation of the SOC subscales (Antonovsky, 1993), empirical studies on a subscale level are entirely missing. From a theoretical point of view, individuals with a stronger external and weaker internal LOC may perceive life as unstructured and unpredictable. At the same time, although unlikely one can imagine an individual that perceives life as completely under the control of others or spiritual entities, while their behavior can be seen as structured and predictable (even if not in their

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[7] Unfortunately, Antonovsky's work (1991) does not contain details on the relationship between these "generalized personality orientations" (p. 70) and SOC. However, they are supposed to constitute similar personality traits (T. L. Smith & Meyers, 1997).

own control). Thus, the SOC components *manageability* and *comprehensibility* demonstrate theoretical associations with LOC (and particularly a stronger internal LOC). However, both concepts can be dissociated on a theoretical level.

Despite such theoretical distinctions, empirical research into the association between SOC and LOC demonstrated a substantial correlation. For example, Flannery et al. (1994) found a correlation of $r = -.49$ between SOC and an external LOC in a student sample. Of note, they reported a stronger association between SOC and symptoms of depression and anxiety than between external LOC and those symptom measures. Similar correlations between SOC and LOC ($r_{internal} = -.36$; $r_{external} = .37$) were described in a sample of police trainees at the beginning of their careers (Bekwa & Beer, 2009) and in two further student samples (Sample 1: $r_{internal} = -.55$; Sample 2: $r_{internal} = -.57$) (Johnson, 2004; T. L. Smith & Meyers, 1997). These strong associations between SOC and LOC were not supported by all studies, for instance, Rennemark et al. (2009) found no significant association ($r = .04$) in elderly attending primary health-care services in Sweden. However, most cross-sectional studies described a robust association between both concepts, in terms of higher levels of SOC being linked to a stronger internal and weaker external LOC.

Notably, with the exception of a study by Flannery et al. (1994), which found SOC to be the strongest predictor of depressive and anxiety symptoms, research into the unique predictive value of SOC and LOC for general mental health problems and posttraumatic stress symptoms is entirely missing. Overall, although the conceptual overlap between SOC and LOC is smaller than SOC's overlap with trait-resilience, both concepts share a substantial amount of variance reflected in medium to large cross-sectional correlations (Cohen, 1988). To further elaborate the overlap between SOC and LOC, future studies should analyze their association in greater detail, particularly with respect to internal and external control beliefs individually (Gore et al., 2016) and looking at specific SOC components (i.e., *manageability* vs. *comprehensibility*). Moreover, these studies - preferably longitudinal in design - should focus on the unique impact of SOC and a stronger internal or external LOC on psychopathological symptoms.

2.4.3 OTHER HEALTH-BENEFITTING CONCEPTS

Trait-resilience and (an internal or external) LOC are not the only concepts demonstrating a conceptual overlap as well as a strong empirical association with SOC. The following section will provide an overview of other health-benefitting factors that should be taken into consideration in the context of salutogenesis and SOC. Since they are only of importance for one manuscript included in this thesis (*Study 5*), they will be introduced more briefly than trait-resilience and LOC. This should not be interpreted as a statement on their relevance to resilience or mental health. However, they are also less frequently studied.

2.4.3.1 SELF-EFFICACY

One concept often discussed in the context of resilience is self-efficacy. Perceived self-efficacy is defined as an individual's sense of control over one's environment and reflects the belief of being able to master demands by acting in an adaptive way (Bandura, 1977). According to Bandura's (1977) social cognitive theory, self-efficacy beliefs are formed based on four sources (Pajares, 2003): firstly, and most importantly, individuals interpret results of their own performance, whereby successful mastery enhances and failure weakens perceived self-efficacy. Secondly, self-efficacy beliefs are vicariously impacted by observing others when performing relevant tasks. Along with peer modeling, these observations - depending on the perceived competence of others - powerfully influence the development of one's self-perception of general competence. A third source of self-efficacy beliefs are verbal messages (e.g., compliments on mastery experiences or general competence) by others. In general, positive feedback of others will strengthen one's self-efficacy beliefs while negative opinions will lower perceived self-efficacy. Physiological states (e.g., stress or anxiety) in the course of mastering demands provide a fourth source of information that forms self-efficacy beliefs.

Although self-efficacy has also been shown to be related to posttraumatic recovery (Benight & Bandura, 2004) and to PTSD symptom severity following collective trauma (Luszczynska, Benight, & Cieslak, 2009) in two meta-analyses, research investigating self-efficacy in the context of salutogenesis or its relationship with SOC is scarce. From a theoretical point of view, again, the strongest overlap may exist with the SOC component *manageability*. As opposed to LOC, which is concerned with the perception of control, high levels of perceived self-efficacy are related to the expectation of a positive outcome. However, unlike SOC, high levels of self-efficacy reflect the belief that a desired outcome is achieved - directly or indirectly - by one's own actions, while SOC's *manageability* component also includes the use of external resources (and hence the actions of powerful others or the intervention of spiritual entities). Notably, also the use of external resource could indirectly result in high levels of self-efficacy (i.e., the perception of being in control of one's environment by mobilizing external resources or the help of others). Antonovsky, who was aware of the concept of self-efficacy when he developed the salutogenesis framework, conceptualized self-efficacy as one aspect of a set of "generalized personality orientations" (Antonovsky, 1991, p. 70) and salutogenic strengths. A narrative review study aiming to synthetize the concepts of SOC and self-efficacy (Posadzki & Glass, 2009) raised the questions whether (G)RR may be developed by the use of self-efficacy or whether higher levels of SOC may strengthen one's perception of self-efficacy. Comparing both theories, the authors outlined different links between the concepts but concluded that they cannot be fully integrated due to their different nature: salutogenesis and SOC were developed against a sociological and philosophical background while Bandura's concept of self-efficacy (1977) originates from research into social cognition and was later 'translated' to the area of mental health.

Beyond the inconclusive theoretical integration of both concepts, empirical research demonstrates a robust association between SOC levels and perceived self-efficacy. For instance, a three-year longitudinal study assessing self-efficacy and SOC and their association with general mental health problems at ages 16 and 19 revealed a significant and stable positive relationship between SOC and self-efficacy ($r_{16\,years} = .56$ and $r_{19\,years} = .51$) (Kröninger-Jungaberle & Grevenstein, 2013). Both SOC and perceived self-efficacy exhibited a significant cross-sectional and longitudinal relationship with general mental health problems and none of the health-benefitting factors became redundant in a SEM including both. However, their unique impact was not directly contrasted in the SEM or a multiple regression model. These findings are also in line with a study that proposed to integrate the concepts of SOC, self-efficacy, and optimism using the umbrella term of 'positive health attitude' (Posadzki, Stockl, Musonda, & Tsouroufli, 2010). In a sample of college students, the cross-sectional association between SOC and self-efficacy was $r = .45$. However, unfortunately, this study did also not compare their unique association with relevant mental health outcomes.

Thus, there is a robust positive relationship between SOC and self-efficacy ranging from medium to large effect sizes (Cohen, 1988). However, little is known about the association of self-efficacy with different SOC components and there are no studies that directly contrast the predictive value of SOC and self-efficacy for mental health outcomes. Future studies may address these aspects and would thereby also inform the debate on the theoretical overlap of both concepts.

2.4.3.2 HARDINESS

The concept of hardiness as a resistance factor originates from medical research into stress and was initially introduced by Kobasa (1979). Hardiness is conceptualized as a personality trait that enables individuals to maintain their mental health even when they are exposed to severe stressors. The core aspect of hardiness as a trait was defined as "the use of ego resources necessary to appraise, interpret, and respond to health stressors" (Pollock, 1989, p. 53). Similar to SOC, hardiness is proposed to comprise three dimensions: *commitment*, *control*, and *challenge*. *Commitment* is defined as one's disposition to strongly involve oneself in whatever one is doing, related to a sense of purpose and meaning (Kobasa, Maddi, & Kahn, 1982). On a behavioral level, committed individuals are assumed to be active and approaching instead of passive and avoidant. The second component *control* is conceptualized as one's disposition to feel and act impactful as opposed to helpless. Individuals believe that they are able to influence their environment via imagination, knowledge, skills, and decisions. The third component *challenge* represents one's ability to accept change rather than stability as the norm in life. Individuals with high scores on the *challenge* component view change as interesting and as an opportunity of personal growth. Thereby, changes are less likely perceived as a threat to one's security. Hardiness has been shown to be robustly related to different aspects of mental health (Eschleman, Bowling, & Alarcon, 2010). Notably, there is no clear distinction between trait-resilience and hardiness. In early research on hardiness the Hardiness Scale

(Kobasa et al., 1982) was used for its assessment. However, this scale exhibited some psychometric problems and was revised into the Dispositional Resilience Scale (Bartone, 1991, 2007) still aiming to assess hardiness. Since not all measures of trait-resilience are based on the hardiness concept (and vice versa), for the purpose of the current thesis trait-resilience and hardiness are understood as related, but different concepts.

On a theoretical level, there is a great overlap between SOC and hardiness. As already stated for LOC, perceived self-efficacy, and sense of mastery, hardiness also constitutes a "generalized personality orientation" according to Antonovsky (1991, p. 70). Sullivan (1993) compared both concepts theoretically and described overlaps as well as differences. *Commitment* is related to the SOC component *meaningfulness*. Thereby, hardiness - different from LOC and self-efficacy - also comprises the relevance of perceiving life as purposeful. A difference is evident in the concept of *control* in hardiness, which is similar to control in the LOC theory (Rotter, 1966), where high levels of control are always related to the perception that oneself is in control over behavioral outcomes. By contrast, *manageability* - as the related component of SOC - only describes an individual's perception that events are under control, which may also be exercised by others. *Challenge* as the third component of hardiness may be seen as a facet of *meaningfulness* in SOC (Sullivan, 1993) and does not constitute a SOC component on its own. At the same time, *comprehensibility* as a part of SOC is not explicitly an element of the hardiness concept.

On an empirical level, some older studies tried to differentiate the concepts of SOC and hardiness. For example, Kravetz et al. (1993) investigated the relationship between SOC total scores and the three hardiness components as well as their associations with mental health in a sample of male patients suffering from coronary heart diseases. The correlations between SOC and the hardiness components ranged from $r = .31$ to $r = .48$. Both, SOC and the hardiness components exhibited a negative relationship with depression and anxiety symptoms, whereby the bivariate correlations between SOC and depression ($r = -.48$) and anxiety ($r = -.53$) were significantly larger than those between the hardiness scales ($r \leq -.33$)[8] and the respective outcomes. However, unfortunately, the concepts were not analyzed as predictors of mental health in a joint model. In line with these findings, a meta-analysis based on four studies and 1,147 participants reported a weighted mean correlation of $M(r) = .50$ between SOC and hardiness (Eschleman et al., 2010). This robust cross-sectional relationship between SOC and hardiness has also been shown in a sample of liver transplant patients (Newton, 1999) and in student samples (Skirka, 2000; T. L. Smith & Meyers, 1997; von Bothmer & Fridlund, 2003).

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[8] A post-hoc two-sided *z*-test for dependent correlations conducted by the author of this thesis did reveal a significant difference for anxiety symptoms, $z = -3.09$, $p = .001$, and depression, $z = -2.62$, $p = .004$. The two-sided *z*-test was calculated based on the correlations between SOC and the *Z*-transformed mean correlations of the hardiness scales and anxiety and depressive symptoms.

Overall, SOC and hardiness exhibit a conceptual overlap, particularly relevant to the facets *commitment* (hardiness) and *meaningfulness* (SOC), which is also reflected in a substantial correlation between both concepts. Despite these findings, which mainly rely on specific patient samples or students, studies contrasting the unique predictive value of SOC and hardiness for mental health are completely missing.

2.4.3.3 SENSE OF MASTERY

The concept of (sense of) mastery was developed in the context of research on coping processes and is defined as "the extent to which one regards one's life-chances as being under one's own control in contrast to being fatalistically ruled" (Pearlin & Schooler, 1978, p. 5). Thus, individuals with a strong sense of mastery perceive themselves as individually powerful and self-determined with respect to developments and changes in their lives. Sense of mastery has been shown to be related to various outcomes including mental health (Schieman & Turner, 1998) and to be protective against the development of PTSD symptoms in a sample of Israeli students (Gil & Weinberg, 2015).

With respect to the theoretical overlap between SOC and sense of mastery, SOC as part of the salutogenesis theory represents the broader theoretical framework (Surtees, Wainwright, Luben, Khaw, & Day, 2006), whereas sense of mastery may be seen as one component of such a framework. As with LOC, self-efficacy, and the hardiness component *control*, the strongest link between SOC and sense of mastery is evident in the SOC component *manageability*. Similar to the *control* component in the hardiness concept, sense of mastery is focused on the perception that life events are under one's personal control, while the SOC component does not define the origin of control, which may also be executed by (well-meaning) others or spiritual entities. Consequently, *manageability* levels do not need to be low if outcomes are perceived as strongly externally controlled, while this would immediately result in low levels of sense of mastery.

Empirically, several studies demonstrated a substantial relationship between SOC and sense of mastery. For example, Pallant and Lae (2002) reported a correlation of $r = .54$[9] between SOC and sense of mastery in the general population. In this study, both SOC ($r = -.51$) and sense of mastery ($r = -.44$) were significantly related to general mental health problems, with SOC showing the numerically larger correlation. However, their associations were not significantly different[10]. A recent study validating a new three-item SOC scale demonstrated even larger positive correlations between SOC and sense of mastery in a student sample, ranging from $r = .60$ to $r = .68$ depending on the version of the SOC scale (Chiesi, Bonacchi, Primi, Toccafondi, & Miccinesi, 2018). These findings are in line with results from a Japanese general population sample that demonstrated

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[9] Correlations were reported controlled for responding tendencies influenced by social desirability.

[10] A post-hoc two-sided z-test for dependent correlations conducted by the author of this thesis did not reveal a significant difference, $z = -1.76$, $p = .078$.

associations larger than $r = .60$ between SOC and sense of mastery (Togari & Yonekura, 2015). Even though both studies assessed mental health, associations between sense of mastery and mental health were not reported precluding the comparison of bivariate associations. Furthermore, to the knowledge of the author of this thesis, no study exists that directly contrasts the unique predictive value of SOC and sense of mastery for general mental health problems or PTSD symptoms. By far the largest study on both concepts conducted by Surtee et al. (2006) only investigated their longitudinal predictive value for mortality during a 6-year follow-up period and found that both concepts were significant predictors of all-cause mortality, with sense of mastery accounting for a significantly larger amount of variance than SOC (15% vs. 10%).

Thus, sense of mastery, which is very similar to the internal dimension of LOC, demonstrates a robust cross-sectional relationship with SOC, reflected in large effect sizes (Cohen, 1988). However, little is known on their unique predictive value for general mental health problems and PTSD symptoms. A post-hoc analysis on the only study reporting their cross-sectional correlation with mental health problems demonstrated strong associations for both concepts, which were not significantly different. But future studies need to investigate their unique association with mental health problems and PTSD symptoms in greater depth using joint models.

2.4.3.4 DISPOSITIONAL OPTIMISM

Dispositional optimism as a concept relevant to coping processes was introduced by Scheier and Carver (1987) as a component of their self-regulation approach. Optimism is a cognitive construct since it represents the expectancy of future outcomes, meaning that optimistic individuals tend to expect a good rather than a bad outcome (Carver & Scheier, 2014). The concept of dispositional optimism characterizes the enduring tendency of an individual to be optimistic about future outcomes. Research on optimism was closely related to the development and use of the Life Orientation Test (Scheier & Carver, 1985) and its revised version (Scheier, Carver, & Bridges, 1994). Dispositional optimism was shown to be related to various health outcomes including mental health (Andersson, 1996; Rasmussen, Scheier, & Greenhouse, 2009) and was also found to be predictive of the development of PTSD symptoms (Gil & Weinberg, 2015).

Theoretically, dispositional optimism was mainly developed as a central source of motivation (Carver & Scheier, 2014). Due to the expectancy of positive outcomes, individuals with high levels of dispositional optimism are supposed to develop sufficient motivation to engage in effortful behavior and to remain focused. On the other hand, individuals with high levels of pessimism[11] generally expect the bad rather than the good things to happen and will not be motivated by the

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[11] In line with Carver and Scheier (2014), for the purpose of the current thesis dispositional optimism will be understood as unidimensional bipolar continuum (ranging from pessimism to optimism). For a discussion on its dimensionality see Segerstorm et al. (2011).

expectancy of an achievable goal. Thus, they will not act. Motivation to use coping processes is only one aspect of salutogenesis and its key component SOC (Antonovsky, 1996). Within the salutogenesis framework, mainly the SOC component *meaningfulness* is assumed to provide the individual with sufficient motivation to engage in coping behavior by establishing the belief that demands in life are worth the cognitive and emotional investment and commitment, which in turn, leads to the experience of purpose in the midst of life challenges (Antonovsky, 1979, 1985). Thus, motivation in the context of salutogenesis is not related to the expectancy of positive outcomes in general. Moreover, in his later work Antonovsky highlighted that unlike other concepts "SOC is not a culture-bound construct. What gives one a sense of meaningfulness; which type or style of resource one thinks is appropriate to apply to a given problem; in whose hands the resources are, as long as they are in the hands of someone 'on my side' (e.g.[,] God, a friend); how much information one thinks one needs to comprehend - the substantive answers to these questions may vary greatly from culture to culture, from situation to situation" (Antonovsky, 1996, p. 15). It is not entirely clear from Antonovsky's work, if his criticism of culture-bound constructs also includes the concept of dispositional optimism. However, according to Scheier and Carver (1987) the idea of a culture-free construct also applies to optimism. Different from other concepts, high levels of optimism equate the expectancy of positive outcomes irrespective of the process that is required to achieve these outcomes. Hence, these expectancies may be caused by any reason, i.e., "because of personal efficacy, because the person is lucky, because he or she is favored by God" (Scheier & Carver, 1987, p. 171). The notion that optimism is not strongly dependent on cultural influences was also supported by a meta-analysis spanning 22 nations (Fischer & Chalmers, 2008), which described only small cross-cultural differences. Besides that, there are little cross-references between salutogenesis and dispositional optimism from a theoretical point of view. One might argue that the overlap is evident in *meaningfulness*, which is also thought to motivate coping behavior, with the distinction that high levels of *meaningfulness* could but do not need to result in the expectancy of a positive outcome. However, the expectancy of a positive outcome is relevant to *manageability* but requires the successful use of (G)RR.

From an empirical point of view, several studies demonstrated a strong cross-sectional correlation between SOC and dispositional optimism as measured by the Life Orientation Test (Revised) (Scheier & Carver, 1985; Scheier et al., 1994). For instance, Pallant and Lae reported a strong positive correlation[12] of $r = .53$ between SOC and dispositional optimism in the general population, which was significantly larger in female ($r = .61$) than male ($r = .38$) respondents[13]. The robust

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[12] Correlations were reported controlled for responding tendencies influenced by social desirability.

[13] A post-hoc two-sided z-test for independent correlations conducted by the author of this thesis did reveal a significant difference, $z = 3.17$, $p = .001$.

association was further supported by a study using a student sample ($r = .58$)[14], which was also predominantly (72%) female (Chiesi et al., 2018). However, a further study also using a student sample reported a positive but weaker association between SOC and dispositional optimism ($r = .30$) (Posadzki et al., 2010). Unfortunately, the latter study did not provide any information on respondents' gender. A strong relationship of $r = .62$ was also found in a gender balanced sample of patients (47% females) in postoperative recovery from an elective surgery (Chamberlain, Petrie, & Azariah, 1992). Moreover, the authors investigated the ability of SOC and dispositional optimism to predict postoperative recovery (i.e., life satisfaction, psychological well-being, psychological distress, self-rated health, and pain severity). Taken together, SOC and optimism were predictive of only the positive outcomes (i.e., psychological well-being and self-rated health). However, only SOC accounted for a unique amount of variance in symptom changes. Moreover, Grevenstein et al. (2016) demonstrated that SOC outperforms optimism (as well as trait-resilience and self-compassion) regarding its relationship with general mental health problems. On a process level, a longitudinal study on cancer patients and their partners demonstrated that the negative relationship between SOC and psychological distress (i.e., symptoms of depression and anxiety) was partly mediated by dispositional optimism in patients as well as in their partners (Gustavsson-Lilius, Julkunen, Keskivaara, Lipsanen, & Hietanen, 2012). These findings suggest that dispositional optimism may function as a motivational structure partly mediating the positive influence of SOC on mental health. However, the impact of SOC does not seem to be fully accounted for by dispositional optimism. Such a partial mediation hypothesis was also supported by findings on mental health outcomes in an adolescent sample (Krok, 2015), where dispositional optimism partly mediated the relationship between SOC and psychological well-being, positive and negatives affect as well as life satisfaction.

Overall, cross-sectionally SOC and dispositional optimism exhibit a strong positive relationship in most of the studies. Findings are currently inconclusive regarding the influence of respondents' gender on the observed association of both concepts. Thus, future studies should address this aspect. If their unique influence on mental health problems was assessed, SOC tended to show the larger association with outcome measures. Some studies also suggested that the relationship between SOC and mental health problems might partly be mediated by dispositional optimism. Despite the strong empirical association reflected in large correlation coefficients, research on the theoretical overlap of SOC and dispositional optimism is rare.

2.4.3.5 Openness to Experience

Openness to experience is distinct from the previously mentioned health-benefitting factors, since the openness to experience concept does not originate from research into health, stress, and coping. Along with conscientiousness, extraversion, agreeableness and neuroticism, it is one of the 'Big Five'

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[14] Weighted mean across all SOC measures.

personality traits (Costa & McCrae, 1992). Among the 'Big Five' openness to experience is the weakest factor in replication studies (McCrae & Sutin, 2009), which might be caused by its vague conceptualization[15]. For the purpose of the current thesis, the conceptualization according to the NEO-PI-R (Costa & McCrae, 1992) will be used. According to the NEO-PI-R (Costa & McCrae, 1992) openness to experience is characterized by multiple facets, namely values, fantasy, aesthetics, ideas, feelings, and actions. Individuals scoring high on openness to experience are thus seen as "imaginative, sensitive to art and beauty, emotionally differentiated, behavioral flexible, intellectually curious, and liberal in values" (McCrae & Sutin, 2009, p. 258). Although not conceptualized as a resistance resource per se, openness to experience has been shown to be positively correlated with (mostly physical) health (Ironson, O'Cleirigh, Schneiderman, Weiss, & Costa, 2008; Jonassaint et al., 2007). Moreover, it was also found to be related to physiological stress reactions, that is, individuals with higher levels of openness to experience exhibited less intensive stress reactions in a laboratory stress paradigm (Williams, Rau, Cribbet, & Gunn, 2009). And lastly, while a 2005 meta-analysis did not find a significant association with mental disorders (Malouff, Thorsteinsson, & Schutte, 2005), a more recent review suggests that openness to experience is moderately positively correlated with posttraumatic growth (Schubert et al., 2016). However, its relationship with PTSD symptoms has not yet been conclusively established (DeViva et al., 2016; Jakšić, Brajković, Ivezić, Topić, & Jakovljević, 2012).

To the knowledge of the author of this thesis, there has been little research into the conceptual overlap between the concepts of SOC and openness to experience. One component of openness to experience is behavioral flexibility, which would also apply to individuals with higher levels of SOC. Moreover, SOC is also assumed to initiate emotional coping with life stressors (Singer & Brähler, 2007), which may relate to emotional differentiation in openness to experience (McCrae & Sutin, 2009). Furthermore, Hochwälder (2012) suggested that 'open' individuals are more curious, imaginative and enjoy exploring, which should in turn increase the SOC components *comprehensibility* and *meaningfulness*. However, there is no study that explicitly addresses or tests these assumptions, which remain speculative.

Feldt et al. (2007) investigated the relationship between SOC and the 'Big Five'. In a sample of 42-year old Finnish participants, who were part of a larger longitudinal study, they found a significant correlation between SOC and openness to experience in women ($r = .31$) but not for men ($r = .07$). Both correlations were significantly different. In a former study focused on predicting health based on multiple factors including the 'Big Five' and SOC, there was no significant correlation between

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[15] Specific conceptualizations of openness to experience vary also between different measures of personality (i.e., NEO-PI-R, Big Five Inventory, etc.). Notably, different measures of openness to experience are significantly correlated (McCrae & Sutin, 2009) suggesting large overlaps between different conceptualizations of openness to experience.

SOC and openness to experience ($r = .12$) (Ebert, Tucker, & Roth, 2002). Moreover, SOC showed a significantly stronger relationship with psychological well-being ($r = .58$) than openness to experience ($r = .12$)[16]. However, another study - using a solely female sample - found a significant relationship between SOC and openness to experience ($r = .28$) (Ruiselová, 2002), which was further supported by other studies (e.g., Bachem & Maercker, 2016; Kardum & Hudek-Knezevic, 2012). In a larger study using a randomly selected sample of the general population in Sweden, SOC was not found to be related to openness to experience, neither in women ($r = .12$) nor in men ($r = .06$) (Hochwälder, 2012). There is only one study directly comparing SOC's incremental validity beyond the 'Big Five' to predict mental health problems. This study found a small and non-significant relationship between SOC and openness to experience ($r = .07$) and a strong unique predictive value of SOC above the 'Big Five' (including openness to experience) (Grevenstein & Bluemke, 2015).

Taken together, compared to other health-benefitting factors the relationship between SOC and openness to experience as a personality trait is weaker and only inconsistently found across the literature. The current findings suggest that gender might have a moderating role, which should be investigated in future studies using less selective samples. Moreover, the theoretical overlap between SOC and openness to experience is not well elaborated. However, there is evidence indicating the importance of openness to experience in coping with a stressor and its relevance to posttraumatic growth (Schubert et al., 2016), which justifies its investigation in the context of resilience.

2.4.4 SUMMARY: COMMUNALITIES BETWEEN DIFFERENT HEALTH-BENEFITTING FACTORS

All health-benefitting factors - SOC, trait-resilience, LOC, hardiness, self-efficacy, sense of mastery, and dispositional optimism - represent "coping dispositions" (Surtees et al., 2006, p. 103), which exhibit varying theoretical and empirical overlaps. Coping dispositions are characterized as enduring, more or less stable traits that enable an individual to manage internal and external stressors including major life events and trauma. In this context, openness to experience represents an exceptional case, since it is derived from research into central personality dimensions and is related to coping processes rather than constituting a coping disposition or resource itself.

There are three substantial conceptual overlaps between all concepts that vary in their extent - these are the relevance of control beliefs, the expectancy of outcomes, and the role of meaning and purpose to motivate coping behavior (see Figure 3 for a schematic illustration).

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[16] A post-hoc two-sided z-test for dependent correlations conducted by the author of this thesis revealed a significant difference, $z = -5.57, p < .001$.
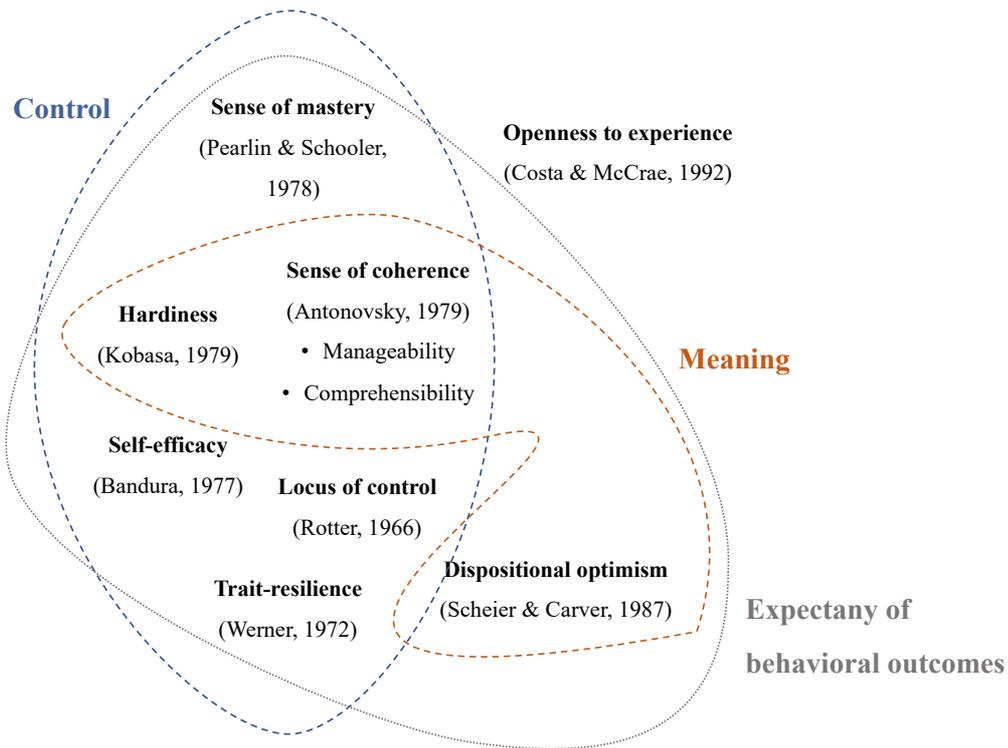
Figure 3. Schematic illustration of the conceptual overlap among different health-benefitting factors and openness to experience as related concept. Notably, inferences in case of trait-resilience depend on conceptualizations varying across different measures.

One aspect relevant to all concepts - except for dispositional optimism and openness to experience - is control. The perception of control is relevant to the SOC components of *manageability* and (to a smaller extent) *comprehensibility*. The importance of control beliefs is even larger for the theories of LOC and sense of mastery. The LOC theory originates from research into control and differentiates a two-dimensional concept of internal and external control perceptions. Particularly perceived internal control is of great relevance to sense of mastery, which represent one's belief to be in control of relevant life changes, which may be seen as a 'translation' of internal LOC to the field of personal life. With respect to hardiness, *control* constitutes one component of the hardiness concept, whereby control is characterized as the belief in one's potential to act impactful. Control beliefs are also relevant to self-efficacy as it is defined as the perception of being in control over one's environment and to execute control to achieve a desired outcome. With regard to trait-resilience the relevance of control beliefs is more difficult to summarize, since a general conceptualization of trait-resilience is missing and its components are dependent on specific measures (Windle et al., 2011). However, control (defined as a stronger perception of internal than external control) also represents one subscale of the CD-RISC (Connor & Davidson, 2003), which can be seen as one of the most relevant trait-resilience assessments. Thus, the perception of control over behavioral outcomes in one's environment can be seen as a key component of these concepts, however, its specific conceptualization differs: except for SOC, all concepts stress the relevance of internal control, while

the SOC concept emphasize the relevance of control in general, which may also contribute to a stronger SOC, if control is present, but exercised by another (well-meaning) and powerful individual or spiritual entity (e.g., God).

Another aspect relevant to many concepts is the expectancy of behavioral outcomes. The expectancy of outcomes has the most central position in the concept of dispositional optimism. Different from all other concepts, the coping disposition of dispositional optimism reflects the general expectancy of a positive outcome irrespective of its origin. To all other concepts, the expectancy of a positive outcome is limited to coping processes or specific demands, for instance, the expectancy to be able to manage a specific stressor or situation (the latter, in case of self-efficacy, which is not limited to stressors). Regarding SOC, outcomes are relevant to the components of *comprehensibility* and *manageability*, since they need to be predictable and logically structured, and a positive outcome (i.e., successful coping) should be achieved by the use of appropriate resources [(G)RR]. Trait-resilience is defined as the ability to cope successfully with a stressor, which thus constitutes the expectancy of a positive outcome. High levels of self-efficacy can also be seen as the ability to influence environmental outcomes, while a positive outcome would represent a successfully mastered demand. The concept of LOC also describes the perceived control over relevant outcomes. However, these outcomes are not characterized as either positive or negative. Control in the hardiness concept is very similar to the internal control concept of LOC, whereby the *control* component represents the perceived influence on relevant outcomes, which are not characterized as positive or negative. This also applies to sense of mastery, with a strong emphasis on internal control over relevant outcomes in life. Thus, the expectancy and nature of outcomes is relevant to most of the concepts. Thereby, outcomes are relevant, since they need to be controlled or are expected as being positive or negative (in general or in terms of successful coping or mastering demands). Especially the latter is of great relevance for motivational aspects of coping.

One component shared by only three concepts - namely, SOC, hardiness, and (partly) dispositional optimism - is meaning, which in turn is supposed to motivate coping behavior. Even though added retrospectively, *meaningfulness* is one of the core SOC components (Mittelmark et al., 2017) and postulated to provide the individual with a feeling of purpose in coping with life stressors. This concept overlaps with *commitment* as a component of hardiness, and partly, with dispositional optimism. However, within the theory of self-regulation as the origin of the optimism concept (Scheier & Carver, 1985) the feeling of purpose that motivates individuals to cope with stressors derives from high levels of optimism, which are seen as a rather stable disposition. In contrast, meaning in the salutogenesis framework and in the theory of hardiness may also be grounded in spiritual or cultural beliefs.

Among these concepts, SOC as the key component of salutogenesis has been characterized as the most comprehensive (Almedom, 2005; Grevenstein, Aguilar-Raab et al., 2016) and some studies investigating various combinations of the aforementioned health-benefitting factors demonstrated

SOC's stronger association with mental health outcomes (Grevenstein, Bluemke et al., 2016; Gustavsson-Lilius et al., 2012; Streb et al., 2014). Moreover, some findings also imply that other health-benefitting factors may act as mediators or moderators within the broader framework of salutogenesis. However, these assumptions need to be further investigated by more comprehensive studies.

3 RESEARCH GAPS

As outlined above, there is a broad range of research investigating the relationship between different health-benefitting factors acting as coping dispositions and mental health. However, the field lacks conceptual clarity (Southwick, Bonanno, Masten, Panter-Brick, & Yehuda, 2014; Surtees et al., 2006). Investigated concepts are often influenced by specific research interests and traditions resulting in concepts that are hard to differentiate on a theoretical level and/or that seem to represent another variety of the same basic idea - for example, sense of mastery as a translation of the concept of an internal LOC to the area of personal life changes. Hence, there is a need for research that assesses health-benefitting factors in large samples using a broader range of outcome measures (i.e., psychopathological symptoms, but also real-life outcomes). Such studies will enable the identification of common underlying factors and allow for a more concise and economical conceptualization of health-benefitting factors that are robustly related to successful coping after exposure to stressors.

Such a conceptualization is of major relevance, since it would enable more efficient research. Future research could focus on a smaller set of relevant health-benefitting factors and investigate their longitudinal relationship with mental health and their predictive value for onset, development and course of psychopathological symptoms following exposure to stressors. Such research may employ well-elaborated methods, which are already successfully applied to the research on trajectories of resilience (Galatzer-Levy et al., 2018). Only such studies would allow for stronger causal conclusions that are essential to inspire interventional research. Thus, findings demonstrating stronger causal relationships may inform further research on the prevention and treatment of PTSD and other stressor-related psychopathological symptoms. Concerning prevention, based on central health-benefitting factors primary prevention may strengthen those factors in individuals at risk for traumatization or major life stressors (i.e., high-risk occupations such as police officers or medical staff) (Horn et al., 2016; Skeffington et al., 2013). Secondary prevention offered to individuals who have been recently exposed to trauma or major life stressors may also profit from a clearer conceptualization of health-benefitting factors that could be included in existing trauma-focused early interventions (Kliem & Kröger, 2013; Roberts, Kitchiner, Kenardy, & Bisson, 2009). Moreover, findings on causal relationships would also allow to study if the inclusion of elements targeting central health-benefitting factors in trauma-focused psychotherapies may improve treatment outcomes in terms of symptom reduction and real-life outcomes (i.e., work absenteeism, social functioning, etc.). If so, these factors may help to reduce PTSD symptoms and/or to prevent future psychopathology in case of later life exposure to trauma or major life stressors. To date, these studies are scarce and do not allow for strong conclusions, since they only focus on specific health-benefitting factors as predictors of treatment outcomes (Böttche, Kuwert, Pietrzak, & Knaevelsrud, 2016).

Thus, an increase in clarity of the definitions of health-benefitting factors associated with general mental health problems and/or PTSD symptoms following life stressors or trauma, is strongly needed to constitute a base for future research investigating temporally causal relationships. Moreover, these could represent the ground for interventional research including health-benefitting factors.

3.1 RESEARCH QUESTIONS AND AIMS

The current dissertation project aims to address these gaps and to investigate the particular relevance of SOC as a central health-benefitting factor in the context of trauma and adversity. For this purpose, the project used both field studies as well as meta-analyses to synthesize existing research in the field of health-benefitting correlates of psychopathology.

All studies expect for *Study 4* are investigating the relationship between SOC and PTSD symptoms. From a theoretical perspective, SOC as the key component of the salutogenesis framework is conceptualized in a comprehensive way (Almedom, 2005), supposedly exceeding the theoretical extent of similar but more narrowly defined concepts such as LOC, self-efficacy, sense of mastery, and dispositional optimism. Correspondingly, empirical studies also underline SOC's relevance for the development of stressor-related psychopathological symptoms (Engelhard et al., 2003; Streb et al., 2014). However, the mean population effect of the relationship between SOC and PTSD symptoms following trauma and major life stressors remains unknown due to heterogenous effect sizes reported on a single study level. *Study 1* aimed to answer this question by providing a first meta-analytical estimation of the population effect.

Building on the meta-analysis on the relationship between SOC and PTSD symptoms, three aspects were of interest: firstly, to investigate SOC's association with a broader range of measures of psychopathology than only posttraumatic stress symptoms, since life stressors and exposure to trauma may also result in mental health problems other than PTSD (Spijker, Jones, Duijff, Smith, & Christey, 2018). Secondly, to compare SOC's unique association with psychopathological symptoms to other health-benefitting factors (e.g., trait-resilience) and thirdly, to investigate this relationship in a sample at serious risk for trauma, critical incidents, and major life stressors. Such a population is of particular relevance for potential future interventions in terms of primary and secondary prevention. Thus, *Study 2* aimed to investigate the relationship between SOC, trait-resilience, and LOC in a sample of intensive care unit (ICU) and anesthesiology staff members.

Given the small and very specific sample in *Study 2*, *Study 3* aimed to answer these questions in a larger sample comprising different occupational groups (i.e., medical staff, police officers, and firefighters). Thereby, differences between occupational groups could also be addressed.

As these parts of the dissertation project have underlined the particular relevance of SOC to psychopathological symptoms from a cross-sectional perspective, *Study 4* aimed to investigate its impact from a longitudinal perspective in a clinical setting. Thus, for the first time, SOC's role as a

predictor of psychotherapy outcomes was studied in the context of a five to six-week multi-professional intervention in a rehabilitation clinic.

SOC was found to be a particular important correlate of psychopathological symptom severity. However, its unique association with mental health cannot be adequately assessed on a single study level. Existing studies are mostly limited to a specific research tradition (e.g., research into salutogenesis or trait-resilience) and frequently use small samples precluding the investigation of a broader range of health-benefitting factors. Thus, for the first time, *Study 5* of the dissertation project aimed to investigate the relationship between SOC and other health-benefitting factors with posttraumatic outcomes (i.e., PTSD symptoms and posttraumatic growth) on a meta-analytical level. Thereby, this final study aimed to answer the following questions: 1) Which health-benefitting factor demonstrates the strongest cross-sectional relationship with posttraumatic outcomes? 2) What are the unique amounts of variance in posttraumatic outcomes that are accounted for by different health-benefitting factors?

4 OVERVIEW OF MANUSCRIPTS

4.1 STUDY 1: THE RELATIONSHIP BETWEEN SENSE OF COHERENCE AND POST-TRAUMATIC STRESS: A META-ANALYSIS

Schäfer, S. K., Becker, N., King, L., Horsch, A., & Michael, T. (2019). The relationship between sense of coherence and post-traumatic stress: A meta-analysis. *European Journal of Psychotraumatology*, 10(1), 1562839.

Theoretical background. As SOC has been discussed as a potential protective factor in the development and course of PTSD, a large number of studies investigated its association with post-traumatic stress symptoms (e.g., Black & White, 2005). However, single studies that vary in study characteristics such as the measurement of SOC and PTSD symptoms, trauma type and duration, mean age, and gender imbalances per sample provided heterogeneous effect size estimations (Arévalo, Prado, & Amaro, 2008; Engelhard et al., 2003; Streb et al., 2014). Therefore, the purpose of this study was to investigate the relationship between SOC and symptoms of posttraumatic stress for the first time on a meta-analytical level. Using a random-effects model (Viechtbauer, 2010), the meta-analysis should provide both, an estimation of the mean weighted relationship based on zero-order correlations (r) and the investigation of its potential moderators.

Main results and conclusion. The meta-analysis included 47 independent samples reported in 45 studies ($N = 10,883$). After correcting for sampling error, the mean correlation between SOC and PTSD symptoms was $M(r) = -.41$ (excluding four outlying studies: -.39). However, this effect could not be generalized to all types of trauma samples due to substantial remaining heterogeneity. Subsequent analyses on the potential influence of different measures of SOC and PTSD symptoms, trauma types and duration, samples' mean age, and gender imbalances per sample did not reveal any significant moderators. Overall, the meta-analysis demonstrated a substantial correlation between SOC and PTSD symptom severity: higher levels of SOC were associated with lower levels of PTSD symptoms. However, future research should investigate whether the relationship between SOC and PTSD symptom severity is causal. In this regard, lower levels of SOC might be a risk factor for the development of PTSD following exposure to a traumatic event as it has been shown in a longitudinal study that assessed pre-trauma SOC levels (Engelhard et al., 2003). However, it is also plausible to assume that SOC is impacted by the presence of PTSD symptoms, in line with the criticism of SOC as an epiphenomena or an inverse assessment of general mental health problems (Bachem & Maercker, 2016; Geyer, 1997).

Moreover, future studies need to further explore SOC's unique association with PTSD symptom levels. The current meta-analysis only focused on the zero-order correlations between SOC and PTSD symptoms, thereby neglecting potential amounts of shared variance between SOC and other health-benefitting factors such as trait-resilience or self-efficacy.

Thus, whilst identifying a robust cross-sectional relationship between SOC and PTSD symptoms, the meta-analysis mainly identified two research gaps: first, a lack of studies that contrast SOC's association with psychopathological symptoms with other health-benefitting factors. Second, the absence of longitudinal studies addressing the nature of the relationship between SOC and PTSD symptoms. The second study aimed to close one of these gaps by means of a cross-sectional investigation of SOC's unique association with psychopathological symptom levels in a sample that is frequently exposed to various work-related stressors, including traumatic events.

4.2 STUDY 2: MENTAL HEALTH IN ANESTHESIOLOGY AND ICU-STAFF: SENSE OF COHERENCE MATTERS

Schäfer, S. K., Lass-Hennemann, J., Groesdonk, H., Volk, T., Bomberg, H., Staginnus, M., ... & Michael, T. (2018). Mental health in anesthesiology and ICU staff: Sense of Coherence matters. *Frontiers in Psychiatry*, *9*.

Theoretical background. Hospitals, and particularly intensive care units (ICUs), are highly demanding and stressful workplaces. Physicians and nurses working in these settings are frequently exposed to various stressors including emergency situations, patients' death, and team conflicts. In line with this, several studies describe increased rates of PTSD symptoms and other mental health issues in hospital staff (Adriaenssens, Gucht, & Maes, 2015; Chuang, Tseng, Lin, Lin, & Chen, 2016; Epp, 2012; Mealer, Shelton, Berg, Rothbaum, & Moss, 2007). Moreover, studies demonstrated that the psychopathological strain on hospital staff also negatively impacts the quality of provided care (Jensen et al., 2016; Poghosyan, Clarke, Finlayson, & Aiken, 2010). Thus, it is of great relevance to identify factors that lower the risk for the development of psychopathological symptoms at these demanding workplaces. Factors that have been discussed to protect against mental health issues in medical staff and other high-risk populations are SOC (e.g., Kleiveland, Natvig, & Jepsen, 2015) and trait-resilience (e.g., Mealer et al., 2012) as well as an internal LOC (e.g., Kooranian, Khosravi, & Esmaeeli, 2008). Therefore, the aim of the study was to evaluate the unique association of these factors with psychopathological symptoms in an ICU and an anesthesiology unit.

Method. The cross-sectional online survey investigated SOC, LOC, trait-resilience, general mental health problems as well as PTSD symptom levels in nurses and physicians in an ICU and an anesthesiology unit ($N = 52$, 65% female) at a Germany university hospital. General mental health problems were assessed using the ICD-10-Symptom-Rating (ISR) (Tritt et al., 2008) and PTSD symptoms were measured using the PTSD Checklist for DSM-5 (PCL-5) (Krüger-Gottschalk et al., 2017). The Sense of Coherence Scale (SOC-L9) (Singer & Brähler, 2007) assessed SOC, the Resilience Scale (RS-11) (Schumacher et al., 2005) measured general resilience, and LOC was assessed using a four-item scale for the assessment of control beliefs (IE-4) (Kovaleva et al., 2012). Analyses of Pearson bivariate correlation coefficients and regression models as well as path models

were used to examine the unique association of all health-benefitting factors with measures of psychopathological distress.

Main results and conclusion. In line with our hypotheses, SOC, $r = -.72$, $p < .001$, trait-resilience, $r = -.46$, $p < .001$, and internal LOC, $r = .51$, $p < .001$, were negatively correlated with general mental health problems while an external LOC showed a positive association, $r = .35$, $p = .010$. However, in a multiple regression analysis, only SOC remained a significant predictor of general mental health problems, $\beta = -.03$, $t(47) = -3.70$, $p < .001$, and accounted uniquely for 13% of the variance. The same pattern of results was found for PTSD symptoms, $\beta = -.03$, $t(47) = -2.30$, $p = .026$, $\Delta R^2 = .07$, which were highly correlated with general mental health problems.

SOC was found to be the most important correlate of both general mental health problems and PTSD symptoms in an ICU and an anesthesiology unit. This is in line with pervious findings that described SOC as the most relevant correlate of psychopathological symptoms in different samples when contrasted to another health-benefitting concept (Grevenstein, Aguilar-Raab, et al., 2016; Grevenstein, Bluemke, et al., 2016; Streb et al., 2014).

However, several limitations of the study need to be taken into account when interpreting the results: due to problems with recruitment, the sample was small and did not allow for subgroup analyses (e.g., multi-group models contrasting the associations of health-benefitting factors and psychopathological symptom levels in physicians and nurses). The small sample size also negatively impacted the statistical power of the regression analyses, which may have resulted in an underestimation of the unique association between symptom levels and health-benefitting factors that showed a smaller bivariate relationship than SOC. Moreover, all respondents worked at the same university hospital, limiting the generalizability of the findings.

Therefore, our results do not allow for strong conclusions on SOC's unique association with psychopathological symptom levels in larger populations. Such studies would be highly needed to lend further support to existing programs aiming to strengthen SOC in populations at risk for stressor-related psychopathological symptoms (e.g., Ando et al., 2011; Foureur, Besley, Burton, Yu, & Crisp, 2013).

Overall, this cross-sectional study underlined SOC's important role as a correlate of psychopathological symptoms leaving the gap to replicate this finding in a larger population allowing for multigroup path analyses.

4.3 STUDY 3: CORRELATES OF MENTAL HEALTH IN OCCUPATIONS AT RISK FOR TRAUMATIZATION: A CROSS-SECTIONAL STUDY

Schäfer, S. K., Sopp, R., Staginnus, M., Lass-Hennemann, J., & Michael, T. (2019). *Correlates of mental health in occupations at risk for traumatization: A cross-sectional study*. Submitted for publication.

Theoretical background. As hospitals, police stations, and fire departments are highly stressful and demanding workplaces, staff members are regularly exposed to various stressors including traumatic events. Correspondingly, several studies report high rates of mental health issues not only in medical staff (Cañadas-De la Fuente et al., 2015; Su, Weng, Tsang, & Wu, 2009; Wang, Liu, & Wang, 2015), but also in police officers [Brown, Cooper, and Kirkcaldy (1996); Janssens, van der Velden, Taris, and van Veldhoven (2018); Lawson, Rodwell, and Noblet, (2012); but see: van der Velden et al. (2013)] and firefighters (Barger et al., 2015; Harvey et al., 2016; Jahnke, Poston, Haddock, & Murphy, 2016). Despite these challenging circumstances, some staff members manage to sustain their mental health. This study is the first to investigate correlates of mental health among three different occupations at risk for the development of mental health issues.

Method. The cross-sectional online survey investigated different health-benefitting factors, i.e., SOC, trait-resilience, and LOC, and psychopathological symptoms, namely general mental health problems, posttraumatic stress and burnout symptoms, in medical staff ($n = 223$), police officers ($n = 257$), and firefighters ($n = 100$). General mental health problems were assessed using the Brief Symptom Inventory (Franke, 2000) and PTSD symptoms were measured using the Impact of Event Scale-Revised (Maercker & Schützwohl, 1998). The Sense of Coherence Scale (SOC-13) (Singer & Brähler, 2007) assessed SOC, the Resilience Scale (RS-11) (Schumacher et al., 2005) measured trait-resilience, and LOC was assessed using a four-item scale for the assessment of control beliefs (IE-4) (Kovaleva et al., 2012). ANOVA and MANOVA were used to compare symptom levels across different occupations. As in *Study 2*, Pearson bivariate correlation coefficients, regression analyses and path models were used to identify the unique associations of all health-benefitting factors with psychopathological symptom severity. Moreover, multigroup path analyses were applied to compare regression models across occupations. If these revealed relevant differences, z-tests were used to assess differences between specific occupations [following Arble, Daugherty and Arnetz (2018)].

Main results and conclusion. The occupations did not show significant differences concerning general mental health problems and PTSD symptoms. However, with respect to burnout symptoms, significant group differences were found for all subscales, emotional exhaustion: $F(2, 568) = 15.27$, $p_{adjusted} < .001$ $\eta^2 = .05$; depersonalization: $F(2, 568) = 13.97$, $p_{adjusted} < .001$, $\eta^2 = .05$; personal accomplishment: $F(2, 568) = 4.98$, $p = .007$, $\eta^2 = .02$. Police officers showed higher rates of emotional exhaustion and depersonalization than both other groups, while medical staff demonstrated higher rates of personal accomplishment - reflecting lower levels of burnout - as compared to police officers and firefighters. In line with our expectations, among all occupations, SOC, trait-resilience, and an internal LOC were negatively associated with general mental health problems, posttraumatic stress and burnout symptoms. By contrast, all outcome measures were positively correlated with an external LOC. Multiple regression models including all health-benefitting factors as predictors accounted for 56% of the variance in general mental health problems, $F(4, 566) = 179.30$, $p < .001$, and for 27% of the variance in posttraumatic stress symptoms, $F(4,$

493) = 45.18, $p < .001$. Again, among all occupations, SOC was the strongest predictor of both general mental health problems and posttraumatic stress. Additionally, multigroup path analyses yielded only minor differences across occupations. With respect to general mental health symptoms, there were no group differences, $\Delta\chi^2(8) = 12.91$, $p = .115$. However, multigroup path analyses indicated significant group differences regarding PTSD symptoms, which were driven by a stronger influence of an external LOC compared to firefighters, $diff = .31$, $p_{adjusted} < .001$, and medical staff, $diff = .21$, $p_{adjusted} < .001$, while these did not differ.

In line with the results of *Study 2* and previous comparative studies (Grevenstein, Aguilar-Raab, et al., 2016; Streb et al., 2014), SOC was identified as the most important health-benefitting correlate of mental health, this time in a larger and more heterogeneous sample consisting of three occupations at risk for mental health problems. Additionally, the multigroup analyses allowed for the conclusion that the pattern of associations between health-benefitting factors and psychopathological symptoms is similar across different occupations. Thereby, the current study addressed one gap in the literature identified in *Study 1* by analyzing SOC's unique association with psychopathological symptoms in a large sample and by comparing these association across different high-risk occupations.

This leaves the second gap in research identified by *Study 1*: the lack of longitudinal studies that investigate the impact of SOC levels on the development and course of mental health problems. However, such studies are highly needed to allow for further development and evaluation of programs that aim to enhance SOC. Thus, *Study 4* tried to address this gap in a clinical sample using a longitudinal design to predict rehabilitation outcomes based on pre-rehabilitation SOC.

4.4 STUDY 4: PRE-REHABILITATION SENSE OF COHERENCE AS A PREDICTOR OF REHABILITATION OUTCOMES

Schäfer, S. K., Schanz, C. G., Sopp, R., Lass-Hennemann, J., Käfer, M., & Michael, T. (2019). *Pre-Rehabilitation Sense of Coherence as a Predictor of Rehabilitation Outcomes*. Submitted for publication.

Theoretical background. SOC constitutes the key component of Antonovsky's salutogenesis theory (Antonovsky, 1979). It reflects one's confidence that the environment is comprehensible and manageable and that one's life is meaningful. SOC is supposed to develop during childhood and adolescence and to stabilize around the age of 30 (Mittelmark et al., 2017). Much research has demonstrated a strong cross-sectional relationship between SOC and (mental) health (Eriksson & Lindström, 2006). However, there is less research on SOC's temporal stability. Studies investigating the effects of short-term interventions on SOC challenge its proposed stability during adulthood (e.g., Ando et al., 2011; Foureur et al., 2013; Lundqvist et al., 2006; Vastamaeki, Moser, & Paul, 2009).

Moreover, to the best of our knowledge, no study existed that investigated SOC's potential to predict treatment outcomes in psychotherapy. Thus, the aim of *Study 4* was to address this gap in research.

Method. The two-wave longitudinal study consisted of 294 patients receiving inpatient psychotherapeutic (and psychopharmacological) treatment for various psychological disorders at a German psychosomatic rehabilitation clinic. SOC and all outcome measures (i.e., general mental health problems, depression and anxiety symptoms) were assessed twice, within two days of arrival and at the end of patients' stay (after five or six weeks). SOC was measured using the Sense of Coherence Scale (SOC-13; Singer & Brähler, 2007), the HEALTH-49 (Hamburger Module zur Erfassung allgemeiner Aspekte psychosozialer Gesundheit für die therapeutische Praxis; Rabung et al., 2009) was used to assess general mental health problems, while depression was measured using the Beck Depression Inventory II (BDI-II; Hautzinger, Keller, & Kühner, 2006) and anxiety symptoms were assessed by the Beck Anxiety Inventory (BAI; Margraf & Ehlers, 2007).

Main results and conclusion. SOC levels were significantly enhanced after the short-term psychological treatment, $t(167) = 4.51$, $p < .001$, $d = 0.35$, whereas psychopathological symptom levels (i.e., general mental health problems, depression and anxiety symptoms) were significantly reduced. Regression analyses including pre-treatment symptom levels and pre-treatment SOC levels as a predictor revealed that pre-treatment SOC was a significant negative predictor of post-treatment symptom levels for all outcome measures, general mental health problems: $\beta = -.13$, $t(231) = -2.20$, $p = .029$, $p = .042$; depression: $\beta = -.14$, $t(234) = -2.21$, $p = .035$, anxiety: $\beta = -.17$, $t(102) = -2.06$, $p = .042$. However, the amounts of variance explained by SOC were relatively small - 2% for anxiety and 1% for depressive symptoms - and large amounts of variance were explained by shared variances between pre-treatment SOC and pre-treatment symptom levels. Nevertheless, the study provides first evidence that SOC functions as a unique predictor of psychotherapy outcomes. Moreover, in line with previous studies (Breslin, Hepburn, Ibrahim, & Cole, 2006; P. M. Smith, Breslin, & Beaton, 2003; Snekkevik et al., 2003), our findings further challenge SOC's conceptualization as a rather stable orientation that does not change in later life. The current findings are limited by the heterogeneous nature of the sample (i.e., different diagnoses, high rates of comorbidity), and non-standardized interventions. Moreover, due to high rates of missing values for the post-treatment SOC assessment, it was not possible to include post-treatment SOC levels in our analyses, which precluded the use of random intercept cross-lagged panel models, which may have been the most appropriate analysis (Hamaker, Kuiper, & Grasman, 2015). This may have led to an underestimation of SOC's predictive value for treatment outcomes. Thus, further studies need to investigate the longitudinal association between SOC and mental health outcomes in different settings using standardized interventions.

Study 4 used a longitudinal design to assess SOC's predictive value for rehabilitation outcomes. Due to practical limitations it was not possible to assess other health-benefitting factors including

trait-resilience or LOC, leaving the question if these factors, although they were shown to be less relevant in the prior studies (*Study 2* and *3*), would have exhibited the same predictive value. Once more this raises the question of SOC's unique association with psychopathological symptoms and their development and course. Thus, *Study 5* aimed to address this question for the first time on a meta-analytical level.

4.5 STUDY 5: THE RELATIONSHIPS BETWEEN RESILIENCE-RELATED CONCEPTS AND PTSD SYMPTOM SEVERITY: A META-ANALYTICAL INVESTIGATION

Schäfer, S. K., Sopp, R., Wirth, B., Schanz, C. G., Staginnus, M., Becker, N., & Michael, T. (2019). *The relationships between resilience-related concepts and PTSD symptom severity: A meta-analytical investigation*. In preparation.

Theoretical background. The umbrella term 'resilience' encompasses more than the absence of PTSD. However, despite decades of research on resilience (Bonanno, 2004; Davydov, Stewart, Ritchie, & Chaudieu, 2010) its precise conceptualization is currently still debated. Resilience can be seen as a trait variable, a beneficial outcome after being exposed to a stressor or as a dynamic process of 'bouncing back' after being faced with adversity. A broad range of studies has investigated the relationship between health-benefitting concepts and PTSD symptoms or posttraumatic growth. However, a comprehensive meta-analysis on these relationships is still missing. Even more important, apart from single study findings (e.g., Streb et al., 2014, *Study 2* and *3*), little is known about intercorrelations between health-benefitting factors and their unique association with PTSD symptoms and posttraumatic growth. To address this gap, this study aimed to examine the relationship between PTSD symptoms and posttraumatic growth - both being conceptualized as posttraumatic outcomes - and a broad range of health-benefitting psychological concepts, i.e., SOC, trait-resilience, LOC, hardiness, self-efficacy, sense of mastery, dispositional optimism, and openness to experience on a meta-analytical level.

Method. We conducted a literature search in five well-established databases: EBSCOhost (PsycINFO and PsycArticles), PTSDPubs, PubMed, Scopus, and Web of Science. Pearson or Spearman zero-order correlation coefficients (r) were used as primary effect size and were noted for the relationships between all health-benefitting concepts and posttraumatic outcomes as well as for all interrelationships between posttraumatic outcomes or health-benefitting concepts. A random effects meta-analysis was performed using R (R Development Core Team, 2017) and the *metafor* package (Viechtbauer, 2010) and moderator effects were assessed using meta-regression and subgroup analyses. Incremental validity of health-benefitting factors beyond other concepts were assessed using meta-analytical regression models based on path analyses.

Main results and conclusion. The meta-analysis based on 339 studies (including 364 samples) comprising 142,468 individuals. Among all resilience-related factors, SOC ($k = 44$) exhibited the

strongest relationship with PTSD symptoms, $M(r) = -.40$ [95% CI = (-.35) – (-.45)], which remained robust also after excluding one outlier, $M(r) = -.39$ [95% CI = (-.35) – (-.44)]. Associations for trait-resilience ($k = 119$), $M(r) = -.29$ [95% CI = (-.26) – (-.33)], internal LOC ($k = 15$) $M(r) = -.24$ [95% CI = (-.16) – (-.33)], self-efficacy ($k = 29$) $M(r) = -.23$ [95% CI = (-.18) – (-.29)], dispositional optimism ($k = 34$), $M(r) = -.26$ [95% CI = (-.21) – (-.32)], and openness to experience ($k = 13$), $M(r) = -.08$ [95% CI = (-.05) – (-.11)] were significantly weaker. Only the confidence intervals of SOC and hardiness, $M(r) = -.33$ [95% CI = (-.26) – (-.41)] and (inverted) external LOC, $M(r) = -.39$ [95% CI = (-.23) – (-.44)] overlapped after the exclusion of outliers, while sense of mastery did show a significantly weaker association with PTSD systems after exclusion of one outlier sample, $M(r) = -.24$ [95% CI = (-.20) – (-.29)]. Regarding moderator effects, the relationships between PTSD symptoms and SOC, trait-resilience, sense of mastery, and dispositional optimism were stronger with increasing sample age. By contrast, in case of internal LOC, older samples were related to weaker associations. No moderating effects after the exclusion of outliers were evident for gender imbalances per sample, trauma types (i.e., accidents, civil violence, natural disasters, occupational traumas, and war experiences), for short versus long exposure to stressors, and for type of population (i.e., general versus high-risk populations versus samples that ensured criterion A on an individual basis). Expect for sense of mastery, all health-benefitting factors demonstrated a non-significant to small relationship with posttraumatic growth, $M(r) \leq .33$ (self-efficacy). Interestingly, SOC showed a non-significant correlation coefficient, $M(r) = .06.$, $p = .348$, with posttraumatic growth.

Comparing meta-analyses that analysed health-benefitting factors, which were supposed to be closely related based on their theoretical foundation, separately and combined in a joint analysis, did not result in a significant increase of heterogeneity for both, trait-resilience and hardiness as well as (internal and inverted external) LOC and sense of mastery. Thus, all subsequent analyses were conducted treating these concepts as single resilience and control factors.

Two meta-analytical regression analyses investigated the incremental validity of trait-resilience/hardiness and LOC/sense of mastery beyond SOC. Analysing SOC and trait-resilience/hardiness in a joint model did not result in a significant incremental validity of trait-resilience/hardiness, $\Delta R^2 = .01$, $F(1; 107) = 1.35$, $p = .247$, while SOC accounted uniquely for 8% of the variance in PTSD symptoms, $F(1; 107) = 10.92$, $p = .001$. However, both factors share 8% of the variance in PTSD symptoms. The same analysis was conducted for LOC/sense of mastery and again, did not result in a significant amount of incremental validity of LOC/sense of mastery beyond SOC, $\Delta R^2 = .01$, $F(1; 107) = 1.05$, $p = .308$, while SOC accounted for a significant amount of variance even under control of LOC/sense of mastery, $\Delta R^2 = .09$, $F(1; 107) = 11.74$, $p < .001$. SOC and LOC/sense of mastery together shared 7% in the variance in PTSD symptoms.

Overall, the set of meta-analyses demonstrated that SOC is the strongest health-benefitting correlate of PTSD symptoms accounting for 16% of the variance. Firstly, using a meta-analytical regression model, other health-benefitting factors could be compared to SOC with respect to their

incremental validity. Neither trait-resilience/hardiness nor the combination of LOC/sense of mastery - constituting a control factor - accounted for a significant incremental amount of variance beyond SOC underlining the relevance of further research into the prospective relationship between SOC and PTSD symptoms.

5 DISCUSSION

The aim of this dissertation project was to increase our knowledge of health-benefitting factors associated with general mental health problems and/or PTSD symptoms following major life stressors or trauma. In the first study, sense of coherence (SOC) was identified as a strong correlate of PTSD symptoms, *M(r) = -.41* using meta-analytical methods. This finding raised the questions whether SOC would exhibit an equally strong relationship with general mental health problems and whether the relevance of SOC would decrease when other health-benefitting factors are included in a joint model. Consequently, the second study investigated SOC's relationship with both PTSD symptoms and general mental health problems in medical health staff as a high-risk sample. Moreover, in addition to SOC, trait-resilience and locus of control (LOC) were assessed and analyzed in a joint model. In line with previous findings that suggested SOC's incremental validity beyond other health-benefitting factors (Grevenstein, Aguilar-Raab, et al., 2016; Streb et al., 2014), SOC accounted for the largest amount of variance in both, PTSD symptoms and general mental health problems and was the only health-benefitting factor demonstrating incremental validity beyond the others. These findings were further supported by the third study that addressed the same question in a larger sample of three high-risk occupations (i.e., medical staff as in *Study 2*, police officers, and firefighters). SOC was the strongest correlate of PTSD symptoms and general mental health. Due to the large sample size and the increased statistical power, other health-benefitting factors, namely trait-resilience and LOC, remained significant in the joint models. However, they accounted for smaller proportions of variance in mental health. Interestingly, this pattern of results was consistently found across all occupations. The only minor difference evident in the multi-group model was that external LOC exhibited a stronger influence on PTSD symptoms in police officers in comparison to the other occupations. Despite this difference, findings were consistent across all groups: SOC was the strongest correlate of symptom severity. *Study 4* used a longitudinal design and firstly investigated whether pre-treatment SOC levels could predict outcomes of a six-week rehabilitation intervention. In line with our hypotheses, patients with higher pre-treatment SOC levels demonstrated a larger decrease in psychopathological symptoms. Moreover, SOC levels were found to be significantly increased at the end of treatment.

Given that these studies consistently demonstrated the substantial relevance of SOC as a correlate (and predictor in case of *Study 4*) of general mental health problems and PTSD symptoms, it was not surprising that *Study 5* provided a comprehensive meta-analytical examination of SOC's relationship with PTSD symptoms as the primary outcome and posttraumatic growth as the secondary outcome. In contrast to *Study 1*, other health-benefitting factors, namely trait-resilience, LOC, hardiness, self-efficacy, sense of mastery, dispositional optimism, and openness to experience, were also included in the meta-analytical investigation. Using meta-analytical regression analyses and path modeling, SOC was found to be the strongest correlate of PTSD symptoms, *M(r) = -.40*. Conversely, the strong

bivariate relationships between PTSD symptoms and all other health-benefitting factors disappeared when they were analyzed in a joint model with SOC. This supported the notion that other health-benefitting factors exhibit - at the most - negligible incremental validity (as found in *Study 3*) beyond SOC positioning SOC as the most comprehensive concept.

The general discussion of this dissertation is structured into five parts. The first part is dedicated to SOC's role as a particular relevant correlate of mental health (*Study 1, 2, 3*, and *5*), while the second part will focus on insights into the longitudinal relationship between SOC and mental health (*Study 4*). The third part will discuss the relative importance of other health-benefitting factors (*Study 2, 3,* and *4*). Limitations of the current dissertation will be outlined in part 4 and future directions of research into resilience and salutogenesis will be discussed in part 5. The thesis will close with a general conclusion.

5.1 SENSE OF COHERENCE - THE STRONGEST HEALTH-BENEFITTING FACTOR

Overall, the most important and robust finding of the current dissertation project is SOC's role as a particular relevant correlate of PTSD symptoms and general mental health problems, which has been consistently found using different methods (field studies and meta-analyses) and various samples (i.e., high-risk populations, diverse patient cohorts, general population, etc.).

Thereby, these findings are in line with previous research that demonstrated SOC's incremental validity beyond other health-benefitting factors (Grevenstein, Aguilar-Raab, et al., 2016; Streb et al., 2014). Building on these results, it is crucial to ascertain what aspects of SOC are responsible for its strong relationship with mental health compared to other health-benefitting factors. One might argue that SOC is the most comprehensive of the concepts as it comprises elements of control (via *manageability*) as well as spiritual aspects (via *meaningfulness*), which have previously been considered to account for SOC's incremental validity beyond trait-resilience and dispositional optimism (Grevenstein, Aguilar-Raab, et al., 2016). Unfortunately, the current findings do not allow for conclusions on a subscale level due to psychometric issues of the Antonovsky scales (1993) in general and insufficient data on subscale correlations between SOC and PTSD symptoms or posttraumatic growth in the case of the meta-analyses. Moreover, especially the psychometric qualities of the subscales have been questioned: in one study (Ekblad & Wennström, 1997) only the *meaningfulness* subscale demonstrated sufficient psychometric qualities and was included in the analyses, which is also in line with previous criticism on the psychometric qualities (Bachem & Maercker, 2016; Frenz et al., 1993) of the SOC scales (Antonovsky, 1993). Notably, many studies fail to mention any information on psychometric qualities of the SOC (sub)scales and simply report internal consistencies that were provided by Antonvosky (1993), which may indicate that internal consistencies were poor or not even analyzed in these cases. Moreover, for example Grevenstein et al. (2016) that explicitly investigated SOC's incremental validity beyond other concepts for the prediction of mental health, argued that SOC's incremental value might result from its

meaningfulness component, but failed to include the SOC subscales in their analyses. In our online survey, where the subscales showed at the most moderate internal consistencies (Cronbach's α ranged from .56 to .67 vs. .82 for the total scale) (for details see chapter 2.4), we found a trend[17] towards a weaker relationship between the *meaningfulness* subscale and general mental health problems compared to the associations with *manageability* and *comprehensibility*. Thus, although this thesis together with previous research has robustly demonstrated SOC's incremental validity, further investigations are needed to establish the role and value of SOC's different components. However, such research would require their reliable assessment. An improvement in assessment may be achieved by a further revision of the original SOC scales (1993), which does not necessarily need to include a re-definition of their item content and components, as it has been proposed by Bachem and Maercker (2016). Thus, large-scale surveys should further investigate the psychometric properties of the subscales and may also allow for an improvement of psychometric qualities if they use the 29-item version of the scales as well as a larger set of newly generated items to assess the components as defined by Antonvosky.

Interestingly, the relationship between SOC and PTSD symptoms (*Studies 1, 2, 3,* and *5*) and general mental health problems (*Studies 2, 3,* and *4*) was found across very diverse populations. Neither in the first nor the second meta-analysis on the relationship between SOC and PTSD symptoms did the type of population (general population vs. high-risk samples vs. samples that ensured a criterion A trauma on an individual basis) and the duration of exposure to the traumatic stressor (short vs. long) exhibit a significant influence on the magnitude of the effect size. The same applied to comparisons of accidental traumas, war-related traumatic experiences, natural disasters, professional, and medical traumas. Hence, although these factors have been found to impact on PTSD development following traumatic events (Kessler et al., 2017), they do not seem to influence the magnitude of the relationship between SOC and PTSD symptoms. Moreover, the type of SOC measure (13- items vs. 29-item version), which was only investigated as part of *Study 1,* did not exhibit a significant moderator effect. On the one hand, the absence of moderator effects underlines the strong association between SOC and PTSD symptom levels irrespective of individual study and sample characteristics. On the other hand, neither the meta-analysis in *Study 1* nor the second meta-analysis in *Study 5* revealed homogeneous effect sizes, which prevents us from generalizing the relationship to the population. This absence of homogeneity might be explained by moderators that have not been examined (e.g., type of assessment), however also a heterogeneous study quality could account for residual variance in effect sizes.

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[17] A post-hoc two-sided *z*-test for dependent correlations reveal a marginally significant difference between *manageability* and *meaningfulness*, $z = 1.61$, $p = .054$, and between *comprehensibility* and *meaningfulness*, $z = 1.52$, $p = .065$.

Sample age exhibited the only significant moderator effect (*Study 5)*. The absolute value of the relationship between SOC and PTSD symptom levels was found to increase with sample age, whereby stronger associations were found in older samples. Such an association was initially also found in *Study 1*, however, after the exclusion of one outlier (Ferrajão & Oliveira, 2016) sample age was no longer a significant moderator. Interestingly, this cross-sectional finding seems to be in line with the salutogenesis framework, which conceptualizes SOC to increase until around the age of 30 at which points it is assumed to stabilize [Mittelmark et al. (2017); but see: Nilsson et al. (2003)]. Thus, older participants may have already developed a higher and more stable SOC, which in turn, shows a stronger relationship with PTSD symptoms. However, cross-sectional research can only provide first insights into the lifespan perspective of SOC. To fully understand the development of SOC over longer periods of time and as a consequence of age-related processes, prospective studies are indispensable.

5.2 THE LONGITUDINAL RELATIONSHIP BETWEEN SENSE OF COHERENCE AND MENTAL HEALTH

As evident from *Studies 1* and *5*, the largest shortcoming of current research on SOC and salutogenesis is the lack of comprehensive longitudinal studies. Such research is necessary to establish SOC's role as a pre-trauma or pre-stressor protective factor, or as a correlate of current mental health symptom levels. With respect to PTSD, to the best of the knowledge of the author of this thesis, there is only one study by Engelhard et al. (2003) that assessed pre-trauma SOC levels as a risk factor for PTSD symptoms following a traumatic event. Other longitudinal studies in traffic accident victims (Hepp et al., 2008; Schnyder, Moergeli, Klaghofer, & Buddeberg, 2001) assessed SOC levels over a longer period of time, but were not able to include a pre-trauma SOC assessment. These shortcomings result from study planning issues: to consider pre-trauma SOC levels, one would need to assess an extremely large sample of the general population to include a sufficient number of individuals who will be exposed to a traumatic event within a reasonable amount of time, limiting the feasibility of such studies. Conversely, post-trauma SOC levels might not allow for any inferences about the impact of pre-trauma SOC as a protective factor for the development, onset, and course of PTSD, as it is conceivable that SOC levels might be temporarily decreased following exposure to a traumatic event. This might be of particular relevance, since the association of SOC and PTSD symptoms was alternatively explained by SOC being decreased by 'shattered assumptions' (Janoff-Bulman, 1989) after exposure to a traumatic event (Kazmierczak, Strelau, & Zawadzki, 2012). According to this theory, traumatic events can change three fundamental assumptions: the overall benevolence of the world, meaningfulness of the world, and one's perceived self-worth (Janoff-Bulman, 1989). These aspects are also captured in the concept of SOC (particularly the benevolence of the world and its meaningfulness) as well as in the items of SOC measures (Antonovsky, 1993; Bachem & Maercker, 2016). Consequently, low post-trauma SOC

levels might simply reflect the erosion of an individual's core assumptions about the world, making them a poor indicator of pre-trauma SOC levels. This alternative claim could only be rebutted by the assessment of pre-trauma SOC levels.

With respect to the relationship between SOC and general mental health, there is a larger number of longitudinal studies, which convey a heterogeneous picture. For example, Kivimäki et al. (2000) found SOC to be predictive of sickness absence over a three-year period. However, this finding was only evident in a subsample of women and for individuals initially exhibiting high levels of SOC. Moreover, one might also discuss if sickness absence represents an appropriate operationalization of an individual's current mental health status. Furthermore, SOC was found to be predictive of perceived general health over four years, even after controlling for baseline health measures (Suominen et al., 2001). Unfortunately, these studies did not assess health in greater detail than one's general perception of health status, which may be strongly influenced by physical health. Thus, besides existing large-scale longitudinal studies ($N > 500$) that mainly focus on physical health, investigations addressing the role of SOC as a predictor of mental health more elaborated are missing.

Although the current dissertation project could not include such a large-scale longitudinal study that would be strongly needed to inform the research on SOC's longitudinal association with PTSD symptoms and general mental health problems, *Studies 1* and *5* clearly identified the lack of longitudinal studies as main research gap in the field of salutogenesis. Moreover, *Study 4* preliminary demonstrated SOC's ability to predict changes in mental health. In addition to this association between SOC and PTSD symptoms or general mental health problems over longer periods of time, changes of SOC within the course of psychotherapy are also of great relevance. Thus, *Study 4* not only demonstrated SOC changes after a therapeutic intervention, but also firstly found SOC's value predicting symptom changes resulting from a multidisciplinary intervention. Only a small number of previous studies operationalized SOC as a treatment outcome and mostly exhibited pre-to-post changes of SOC following psychotherapy [Lundqvist et al., (2006); but see: Broda (1996)].

Overall, longitudinal research on SOC and the salutogenesis framework needs to be conducted to further investigate SOC's impact of psychopathological symptoms. Such research should address pre-stressor or pre-trauma SOC levels and investigate their relationship with symptom levels over a longer period of time using approaches such as the experience sampling method[18] (ESM) as an intensive data collection technique (Palmier-Claus, Haddock, & Varese, 2019). The use of such techniques would allow for stronger causal inferences and provide deeper insights into interindividual differences (random-effects) and robust processes of change and development, which

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[18] The experience sampling method (ESM), also daily diary method and ecological momentary assessment (EMA), is an intensive longitudinal research methodology asking participants to report on their thoughts, feelings, behaviors, contextual factors and/or environment on multiple occasions over time (Bolger & Laurenceau, 2013).

are consistent across individuals (fixed-effects). Thereby, such analyses could firstly enable the investigation of interindividual differences in coping processes as modeled by the salutogenesis framework. Moreover, they would also provide an opportunity for the examination and real-time assessment of contextual variables such as environmental stressors (i.e., workplace environment, social interactions, etc.). Furthermore, participants' answers might be less influenced by recall biases, that may distort cross-sectional studies as well as longitudinal studies, which are usually based on a smaller number of assessments. Such studies may also benefit from the assessment of multidimensional outcomes, thus exceeding the mere assessment of psychopathological symptoms. They may also include the measurement of positive indices of health (i.e., quality of life, life satisfaction, well-being, etc.), physical health, and real-life outcomes (i.e., social contacts, work absenteeism, etc.), which have been of rising interest (Albani, Blaser, Geyer, Schmutzer, & Brähler, 2011; Hoyer, 2016; Lambert, 2013). Additionally, these studies should also try to operationalize other components of the salutogenesis framework (Antonovsky, 1979, 1987) beyond SOC. The framework itself is much broader and proposes more complex and elaborate mechanisms by which SOC impacts an individual's movement on the continuum between *ease* and *dis-ease*, e.g., through the use of internal and external resources or through cognitive processes that influence the classification of stressors (see chapter 2.2). Methods such as ESM may allow for conclusions on processes and mechanisms, which are essential to test the salutogenesis framework. Such research may be able to close the existing gap between process-orientated hypotheses - as proposed by the salutogenesis framework - and the current main focus of research concerned with mostly simple bivariate cross-sectional relationships.

5.3 OTHER HEALTH-BENEFITTING FACTORS AND THEIR RELEVANCE

Besides the important role of SOC, the current thesis also aimed to elaborate on the concept of SOC in the broader field of resilience. Research into resilience - and particularly trait-resilience - is characterized by a large variety of overlapping health-benefitting concepts derived from different stands of research (Windle et al., 2011). Unfortunately, even research that has examined related concepts (e.g., LOC and sense of mastery), has rarely targeted their theoretical and empirical overlap, further reducing conceptual clarity, and leading to redundancies. Thus, it is important to identify central aspects of these health-benefitting factors to allow future research to concentrate on these.

Building on the theoretical background of all concepts, *Study 5* aimed to identify shared and unique aspects of various health-benefitting factors by means of statistical integration using meta-analytical methods. These analyses illustrated that trait-resilience and hardiness can be integrated into one homogenous factor, which is in line with previous reviews that used these concepts interchangeably (Maltby, Day, & Hall, 2015; Windle et al., 2011). However, especially research on trait-resilience lacks a precise theoretical foundation. Hence, trait-resilience differs from other health-benefitting factors such as SOC (Antonovsky, 1979, 1987) and LOC (Rotter, 1966), which

are based on elaborated - yet underinvestigated - theories. The variance in definitions, operationalizations, and foci also complicates the integration of trait-*resiliencies* and hardiness into one *resilience* factor. One may argue that hardiness (Kobasa, 1979) - as opposed to trait-resilience - has a solid theoretical foundation, which could be applied to the broader field of trait-resilience. As in the case of SOC, hardiness is comprised of three components: *commitment*, *control*, and *challenge*, reflective of the subscales of the Hardiness Scale (Kobasa et al., 1982). However, looking into other measures of trait-resilience, these measures also consist of subscales (Connor & Davidson, 2003; Wagnild & Young, 1993). For example, the frequently used CD-RISC (Connor & Davidson, 2003) encompasses five factors (i.e., personal competence, strengthening effects of stress, secure relationships, control, and spiritual influences) (Gucciardi, Jackson, Coulter, & Mallett, 2011). Hence, it would be inappropriate to infer that the theoretical foundation of hardiness is superior to the theoretical basis of trait-resilience in general. Hardiness simply seems to constitute another variant of trait-resilience assessed and conceptualized by a specific measure. Against the background of a multidisciplinary perspective, Maltby et al. (2015) aimed to refine trait-resilience using five well-established resilience measures (including the Hardiness Scale) and developed a new 12-item resilience measure using exploratory and confirmatory factor analyses. The new scale comprised three factors: *engineering resilience*, *ecological resilience*, and *adaptive resilience*. The first component represents the ability of a system - or in case of psychological resilience, an individual - to rebound, heal, and to return to an equilibrium state after being exposed to a stressor, in line with the consensual definition of resilience as the ability to 'bounce back' after adversity (American Psychological Association, 2014; Southwick et al., 2014). Ecological resilience originates from biological research and describes the ability to be robust, permanent, and persistent. Adaptive resilience, also taken from biology, characterizes an individual's capacity to restructure, transform, and materialize. Thus, it addresses one's potential to adapt to relevant changes in the environment by transforming or changing elements of the system. Interestingly, none of these factors explicitly comprises control, which has been introduced as an important facet in most of the well-established resilience measures. The approach of Maltby et al. (2015) has been developed into a comprehensive ecological system model of resilience (Maltby et al., 2016), which also led to an improved scale to assess system resilience (Maltby, Day, Flowe, Vostanis, & Chivers, 2019). To date, most of the research on the ecological system model of resilience originates from Maltby and colleagues and hence requires independent replication. However, future research will show if the provided theoretical framework and the newly developed scales resolve the conceptual lack of clarity with respect to trait-resilience. Based on the findings of this thesis, the integration of research on trait-resilience and hardiness seems to be appropriate. Future studies should try to identify the central aspects that drive the associations between trait-resilience/hardiness and symptoms of posttraumatic stress, as well as general mental health problems.

From a theoretical perspective the integration of LOC (Rotter, 1966) and sense of mastery (Pearlin & Schooler, 1978) is clearer. Both concepts focus on the impact of control beliefs. The findings of *Study 5* underline the belief that events are controllable by one's action (and not predominantly dependent on factors beyond one's influence) (Rotter, 1966) shows a significant negative association with PTSD symptoms, but that the specific type of its assessment (i.e., internal, external control beliefs or mastery beliefs) has no impact on the magnitude of the relationship. Conversely, recent research favours the separate assessment of internal and external control beliefs over unidimensional LOC measures (Gore et al., 2016). However, based on the findings of *Study 5*, it would be premature to conclude that the type of assessment has no impact on the relationship between control beliefs and PTSD symptoms, since only a few studies used instruments assessing internal and external control beliefs separately (e.g., Hoffman, Shrira, Cohen-Fridel, Grossman, & Bodner, 2016). Also findings from *Study 3* demonstrating a stronger influence of external LOC, as compared to internal LOC and trait-resilience, on PTSD symptoms partly support the notion that an external LOC might be of greater relevance for mental health outcomes and well-being (Gore et al., 2016). Thus, future studies should expand the existing database to allow for stronger inferences regarding the assessment of LOC. Overall, the perception of control over outcomes seems to constitute an important correlate of lower levels of psychopathology following exposure to a stressor. This is further underlined by the fact that other concepts, which were not included in the combined analyses of LOC and sense of mastery, also include control as a relevant component. Control beliefs are part of most conceptualizations of trait-resilience, hardiness and are relevant to SOC, where they contribute to *manageability* and *comprehensibility* (Mittelmark et al., 2017; Sullivan, 1993). However, by demonstrating no incremental validity of the combined concepts of (internal and external) LOC and sense of mastery beyond SOC, our analyses suggest that the concept of control as it is included in SOC sufficiently mirrors the relevance of control among all health-benefitting factors.

Our conclusions concerning the other health-benefitting factors, namely self-efficacy, dispositional optimism, and openness to experience, are less strong. These factors were not included in the field studies of the dissertation project (*Studies 2, 3*, and *4*) and findings on their associations with SOC are rare. Thus, the absence of intercorrelations between SOC and these health-benefitting factors precluded the analysis of the incremental validity of those factors beyond SOC using meta-analytical regression analyses. Such models would have been of interest. In case of dispositional optimism, a previous study suggests that SOC demonstrates incremental validity for the prediction of general mental health outcomes (Grevenstein, Aguilar-Raab, et al., 2016). Given the small relationships between openness to experience and general mental health problems, $M(r) = .10$, and its inverse - but non-significant - relationship with SOC, $r = -.18$ (see Appendix A), it is not very plausible to assume that openness to experience would exhibit strong incremental validity beyond SOC. This is further evidenced by a study that demonstrated SOC's incremental validity beyond the 'Big Five' in predicting general mental health problems (Grevenstein & Bluemke, 2015). Thus,

openness to experience may constitute a correlate or constituent of posttraumatic growth, but does not seem to be of great relevance with respect to PTSD symptoms and general mental health problems (Schubert et al., 2016). However, future studies need to address these questions in greater depth.

Unfortunately, the absence of intercorrelations also hindered the meta-analytical investigation of a potential incremental validity of self-efficacy beyond SOC. Different from openness to experience, self-efficacy exhibited a substantial relationship with PTSD symptoms, *M(r)* = -.23, making a potential increment beyond SOC more relevant. Moreover, studies contrasting the predictive value of self-efficacy and SOC for PTSD and general mental problems are entirely missing. Hence, future studies should address this gap.

5.4 LIMITATIONS

While the current thesis demonstrated the role of SOC as a particular relevant correlate of mental health, some limitations must be taken into account. The most important aspect is the predominantly cross-sectional nature of the findings (except for *Study 4*), prohibiting inferences on causality. All studies robustly supported the existence of a strong cross-sectional relationship between SOC and different measures of mental health (i.e., PTSD symptoms, general mental health problems, and burnout symptoms in case of *Study 3*). These findings are in line with the salutogenesis framework (1979, 1987), which proposes multiple causal mechanisms through which SOC influences mental health, that is an individual's position on the continuum between *ease* and *dis-ease*. For instance, SOC is assumed to influence the classification of internal and external events as stressors or non-stressors (for details see chapter 2.2). Consequently, individuals with higher levels of SOC may perceive events as less stressful and are optimistic that they will be able to cope with occurring stressors through the efficient use of internal and external resources [(G)RR] (Mittelmark et al., 2017). In turn, this efficient way of dealing with challenges could result in lower levels of psychopathological symptoms following exposure to stressors, meaning a movement back into the direction of *ease*. However, the current data - along with most studies into salutogenesis - do not allow for definite conclusions on these conceptual and process-related assumptions regarding SOC within the salutogenesis framework. On the contrary, the current findings can also be explained by alternative associations between SOC and mental health: for example, SOC - as opposed to other health-benefitting factors - could be impacted the most by current mental health problems. Moreover, as criticized in previous work on Antonovsky's concept (Bachem & Maercker, 2016; Geyer, 1997), the SOC scales (Antonovsky, 1993) might show a considerable overlap with instruments assessing mental health, thus assessing depressive and anxiety symptoms rather than a unique health-benefitting factor (Frenz et al., 1993; Geyer, 1997). This criticism also inspired the development of the new Sense of Coherence Scale Revised (SOC-R, Bachem & Maercker, 2016) (see chapter 2.2.1 for detailed information on SOC-R), which is supposed to reduce this overlap and provide a more

realistic estimation of the relationship between SOC and measures of mental health. However, this conceptual criticism is challenged by studies demonstrating SOC's incremental validity in predicting the course of psychopathological symptoms beyond baseline symptom severity. This has been shown in student samples (Grevenstein, Aguilar-Raab, et al., 2016) as well as in clinical populations (see e.g., *Study 4)*. If SOC simply provided another measure of mental health, SOC's predictive value should disappear when controlled for initial symptom levels. Moreover, there is no substantial overlap in item content between the SOC scales (Antonovsky, 1993) and standard measures of depression and anxiety. However, SOC as assessed by the Antonovsky scales might represent an inverse measure of the cognitive triad (negative view of self, world, and future) conceptualized by Beck (1979). Thus, future studies should assess SOC and cognitive aspects of depression and anxiety (e.g., Lovibond & Lovibond, 1995) to test this hypothesis and to shed light on the theoretical differentiation of these concepts. Since a longitudinal approach was missing in *Studies 2* and *3,* as well as in the studies included in the meta-analyses (*Studies 1* and *5*), it is not possible to preclude the notion of SOC being an 'epiphenomenon' of psychopathology based on the current thesis.

Another limitation is related to the assessment of SOC. As previously mentioned, the SOC scales developed by Antonovsky (1993) demonstrate a robust relationship with different aspects of mental health (Eriksson & Lindström, 2006). However, they have been criticized due to poor psychometric qualities. With respect to reliability, the SOC scales demonstrated strong internal consistencies in the current field studies (*Study 2, 3, and 4*) with Cronbach's Alphas ≥ .81. However, one could criticize that all findings are based on different versions (i.e., SOC-29, SOC-13, and SOC-L9) of the same instrument. This may represent a confound and limit inferences on a conceptual level. However, at the same time, the consistent use of one measure can also reduce unwanted variance due to heterogeneous assessment methods (Maul, 2013). As of now, it is not possible to test the influence of the type of SOC assessment on SOC's relationship with mental health due to an insufficient number of studies using the SOC-R (Bachem & Maercker, 2016). However, existing studies using the new instrument indicate weaker relationships, which are partly only evident for specific subscales (Behnke et al., 2019). Future studies will have to address this aspect in greater detail by using both the Antonovsky scales (1993) as well as SOC-R to compare their psychometric qualities and their predictive value with respect to different outcomes.

Moreover, the meta-analyses on the relationships between different health-benefitting factors and PTSD symptoms (*Study 5*) is also limited by its cross-sectional design. Due to an insufficient number of longitudinal studies (39 out of 339 studies in total) per health-benefitting factor, we were not able

to conduct meta-analyses based on longitudinal associations for SOC or any other concept[19]. Therefore, the current findings do not allow for conclusions on the role of the investigated health-benefitting concepts as protective factors. However, such studies and a meta-analysis building on these studies, would be needed to finally conclude that SOC is the most relevant factor influencing the development and course of psychopathology.

5.5 FUTURE RESEARCH

The findings of the current dissertation project provide robust evidence of SOC as a particular important correlate of PTSD symptoms and general mental health following traumatic events as well as in high-risk occupations. Given the incremental validity of SOC beyond other health-benefitting factors that could be demonstrated in two field studies (*Studies 2* and *3*) and which was further supported by the comprehensive meta-analysis on health-benefitting factors (*Study 5*), future studies should focus on the relationship between SOC and mental health. Specifically, research would benefit from three types of studies concerning this relationship.

First, future prospective studies should investigate SOC's role as a potential protective factor for the development of general mental health problems, PTSD and other stressor-related mental disorders. To date, a small number of recent studies investigated SOC as a protective factor in the context of physical diseases (Lindahl, Juneja, Teljigovic, Rafn, & Nielsen, 2019; Lindblad et al., 2018). These studies demonstrate that higher levels of SOC are associated with beneficial outcomes in patients with serious injuries and in women suffering from breast cancer. However, they did not assess individuals' SOC levels prior to exposure to the stressor (i.e., onset of serious physical diseases). In terms of mental health, Remes et al. (2018) demonstrated in a population-based study on women in the UK that SOC predicts the onset of generalized anxiety disorder (GAD) over a five to nine year observational period. However, this association did not apply to the whole sample: Initially lower SOC levels were only related to an increased risk for the development of GAD in women who lived in deprived areas. SOC levels did not influence the risk for GAD among those living in more affluent areas. The authors interpret these findings in terms of more efficient coping mechanisms in those with higher levels of SOC, which are needed to deal with the more stressful environment in deprived areas. Similar studies assessing a broader range of psychopathological symptoms are strongly needed to further investigate SOC's role as a potential risk factor for the

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[19] *Study 5* does include subgroup moderator analyses comparing associations of health-benefitting factors and PTSD symptoms (or posttraumatic growth) between studies using a longitudinal versus a cross-sectional design. However, these analyses are not necessarily based on longitudinal associations, since correlations coefficients were averaged across time if health-benefitting factors and/or PTSD symptoms (or posttraumatic growth) were assessed at multiple times. Averaged effect size estimates of longitudinal studies may thus include cross-sectional correlations.

development of psychopathology. In this context, the observational period is of critical relevance, since the SOC framework comprises a lifespan approach, which could only be investigated if SOC would be assessed starting from early adolescence over a prolonged period of time. Unfortunately, such studies are rare as they are complex and expensive. One larger study intending to provide such information is the Bochum Optimism and Mental Health (BOOM) project (Brailovskaia et al., 2018), which aims to identify protective and risk factors for mental health by analyzing cross-sectional and longitudinal data from international samples. Within this framework, the authors assess SOC along with trait-resilience, dispositional optimism, and LOC, which have also been studied in the current thesis. Unfortunately, to date there are no publications on the longitudinal relevance of SOC as protective factor. If the results of the BOOM project further support the notion that SOC is a relevant predictor of mental health, future prospective studies could investigate this relationship in greater depth using approaches such as ESM (Palmier-Claus et al., 2019). In this context, it would be of particular importance to assess the mediating factors by which SOC impacts on mental health. These might be the recruitment and use of personal resources [(G)RR] or cognitive processes related to the perception of stressors as suggested by the salutogenesis framework (Singer & Brähler, 2007). Such studies may firstly allow to clarify SOC's specific role as a protective factor and to test process-orientated assumptions derived from the salutogenesis theory (Antonovsky, 1979, 1987).

Moreover, from a longitudinal perspective, future studies should also investigate SOC's relevance in dealing with specific stressors. Based on SOC's strong relationship with PTSD symptoms, $M(r) =$ -.40, identified in this thesis, it would be of great importance to assess SOC not only over longer observational periods, but also as a predictor of responses to short-term exposure to stressors. To date, only one study applied such a prospective approach assessing pre-trauma SOC levels (Engelhard et al., 2003) (see chapter 2.3.2.2 for a detailed description). Building on the scarcity of such studies, our group is currently conducting a longitudinal study of police officers as a high-risk occupation, comprising an observational period of six months. At the start of the study, we will assess SOC levels along with trait-resilience and LOC as well as measures of psychopathology (general mental health problems, PTSD symptoms, and burnout) and job performance. After six months, participants are asked to complete the same measures, but including an assessment of exposure to stressors in the last six months. Hopefully, this will enable the first investigation of the impact of SOC on the development of psychopathological symptoms using random intercept cross-lagged panel models (Hamaker et al., 2015), allowing for stronger conclusions on causality. Provided that findings of this and other studies further support SOC's particular relevance, future studies should try to assess samples that lack previous exposure to traumatic events, e.g., police freshmen or soldiers entering the military. By assessing such populations, the potential impact of previous traumas on SOC levels could be controlled.

Second, if SOC's role as a central correlate of mental health is further supported and studies demonstrate its predictive value for the onset and course of mental health problems, future studies

should address the question if SOC could be increased by SOC-targeting interventions. To date, studies demonstrated that short and long psychotherapeutic interventions are able to increase SOC levels (*Study 4*, Lundqvist, Svedin, Hansson, & Broman, 2006). However, SOC trainings might be of even greater importance with respect to primary prevention for PTSD (Skeffington et al., 2013) and other stressor-related mental disorders. For example, soldiers, policemen, and firefighters are frequently exposed to critical incidents and traumatic events, illustrating the potential benefits of such interventions to lower their significantly increased risk for the development of mental health problems (Bonde et al., 2016; Harvey et al., 2016; Lawson et al., 2012). To date, a few SOC trainings already exist (Ando et al., 2011; Davidson, Feldman, & Margalit, 2012; Foureur et al., 2013; Weissbecker et al., 2002), which are, however, not based on robust evidence that supports SOC's role as a protective factor in mental health. Moreover, these studies assess SOC as a key outcome, but do not directly build on the salutogenesis framework. For instance, three studies investigated the impact of mindfulness-based interventions on SOC levels. In a pilot study ($N = 18$), Meghani et al. (2018) offered a mindfulness-based art therapy for cancer patients, who can be perceived as a high-risk sample for the development of PTSD. The eight-week program consisted of weekly sessions of mindfulness walks in the nature, where patients were asked to take photos. These photos were combined with origami paper, colored cloths and whatever the patients wanted to include to form a collage. After completion of the program, the authors described a significant increase in the SOC component *comprehensibility* and a marginally significant improvement in *manageability*. Ando et al. (2011) tested the impact of a similar two-week mindfulness-based stress reduction (MBSR) program on SOC levels in a sample of 15 nurses. Compared to a waiting control group, SOC levels in the intervention group increased significantly. Besides these promising findings, another pilot study using a 12-day MBSR program to enhance SOC levels in professionals of the German catholic church reported increases in SOC scores only in 25% of the participants, while another 50% dropped in SOC levels (Mayer, Viviers, Flotman, & Schneider-Stengel, 2016).

However, although some of these interventions seem to be able to enhance SOC levels, they are not explicitly designed to increase SOC. An intervention that is specifically based on the salutogenesis framework, is the Health Ease and DisEase (HEDE) training (Franke & Witte, 2009). In contrast to the aforementioned MBSR programs, this primary and secondary prevention program developed for healthy individuals and participants at risk (i.e., chronically ill patients) explicitly aims to increase SOC levels by addressing specific aspects of the salutogenesis framework. First, participants are introduced to the concept of salutogenesis. Afterwards, the 10-sessions program focusses on the development of resources [(G)RR], while the last sessions aim to strengthen the specific SOC components - *comprehensibility*, *manageability*, and *meaningfulness*. However, even though the authors describe their intervention as promising, a randomized controlled trial evaluating the HEDE training is still missing. Moreover, a study investigating the cognitive benefits of a stress reduction intervention used the HEDE training as the waiting control condition and did not find a

significant post-intervention increase in SOC levels (Stahn, 2011). Hence, to date, there are promising programs aiming to enhance SOC. Some of these apply well-established interventions like MBSR programs to target SOC levels indirectly, while others build on the salutogenesis framework and address the salutogenesis theory and SOC more explicitly. However, besides the lack of prospective studies that robustly identify SOC as a protective factor, SOC-targeting interventions and SOC trainings need to be evaluated using randomized designs and larger samples.

Third, studies should also assess SOC levels as an outcome of psychotherapy. This would be of particular relevance if high SOC levels were found to constitute a protective factor against the re-development of psychopathological symptoms. If this was the case, low SOC levels following the completion of psychotherapy would put individuals at risk for the re-development of psychopathological symptoms when they are re-exposed to stressors. Thus, given this relationship - which still has to be established in prospective studies - normalizing and/or enhancing SOC levels may be an important goal of psychotherapy. Currently, SOC levels are not regularly assessed as an outcome of psychotherapy. However, studies already demonstrated increases of SOC as a result of treatment, e.g., following a group intervention for traumatized women (Lundqvist et al., 2006), after psychodynamic interventions (Lazar, Sandell, & Grant, 2006; Sack, Künsebeck, & Lamprecht, 1997) as well as in the aftermath of a cognitive behavioral therapy in older populations (Wiesmann, Rölker, Ilg, Hirtz, & Hannich, 2006). However, Broda et al. (1996) reported that SOC levels were not enhanced by a multidisciplinary intervention in a German rehabilitation clinic, which contrasts with our findings in *Study 4*. The call for the regular assessment of health-benefitting factors as an outcome of psychotherapy is in line with a recent review on the treatment of PTSD (Reyes, Kearney, Lee, Isla, & Estrada, 2018). The authors propose to assess (trait-)resilience regularly as an outcome of psychotherapy, in order to extend the focus from reduction of PTSD symptom severity to resources that are available to deal with current and future stressors. Against the background of our findings, especially *Study 5*, SOC as opposed to trait-resilience might represent the more relevant and comprehensive outcome.

Although the findings of the current dissertation project identified SOC as the most important correlate of mental health, future studies need to demonstrate its ability to predict symptom trajectories and how its predictive value compares to other health-benefitting factors. Moreover, to date a study - similar to the online survey presented in chapter 2.4 - that assesses a comprehensive set of health-benefitting factors in a large sample is missing. Maltby et al. (2015) provided such a broad study for the concept of trait-resilience using different variants of factor analysis. Future research should extend these findings by analyzing a comprehensive set of health-benefitting factors in a large representative sample. Such a study would firstly provide information on distinct health-benefitting aspects assessed in one sample that are associated with mental health outcomes and could thereby integrate similar and/or redundant aspects of different concepts.

5.5.1 SENSE OF COHERENCE AND PTSD MODELS

From a theoretical point of view, research into the association of SOC and PTSD symptom levels should incorporate PTSD models as for example the cognitive model of PTSD (Ehlers & Clark, 2000). Unfortunately, to date, research into resilience, and particularly into salutogenesis and PTSD symptoms does not connect these findings to well-established PTSD models. However, these models may provide a fruitful framework to combine different research fields related to trauma and resilience. One may argue that the salutogenesis framework and well-established PTSD models aim to explain different states: the (re-)development of health in case of the salutogenesis (Mittelmark et al., 2017) versus the development and onset of psychopathological symptoms in case of PTSD models (Lissek & van Meurs, 2015). However, building on the salutogenesis framework, the models may aim to explain different pols of the continuum between *ease* and *dis-ease* and may thus be combined.

Within the cognitive model of PTSD, SOC might indirectly influence PTSD symptom severity by being both a predisposition and a mediator of cognitive processes during and after trauma (see Figure 4). According to the cognitive model (Ehlers & Clark, 2000), PTSD is characterized by disturbed memory processes building on characteristics of trauma, but also on previous life experiences, beliefs, and coping strategies of the individual that influence cognitive processing during trauma. In this context, SOC as a global orientation may result from previous experiences, form beliefs, and could contribute to the use of resources and specific coping strategies. By forming these relevant individual predispositions, SOC may influence cognitive process during traumatic experiences and thus, indirectly, affect PTSD symptom levels. Within the cognitive model, these symptoms are caused by the nature of the trauma memory (being fragmented and decontextualized) and the negative appraisal of the trauma and its consequences. The latter is also influenced by the nature of the trauma memory. SOC might be of particular relevance for appraisal processes concerning the trauma and its sequelae and high levels of SOC might also enable an individual to use less dysfunctional control strategies (e.g., avoidance, rumination, etc.) to manage PTSD symptoms.

To date, these notions remain ideas and have not yet been tested empirically. However, future studies should aim to connect these research approaches, which may lead to a substantial improvement of well-established PTSD models (e.g.. Brewin, 2014; Ehlers & Clark, 2000). If these models would include more elaborated information on resilience resources, they may be even more relevant and comprehensive, not just for the development of PTSD treatments, but also for the design of prevention strategies, which may target both - resilience resources like SOC as well as risk factors for the development of PTSD (Brewin, Andrews, & Valentine, 2000).
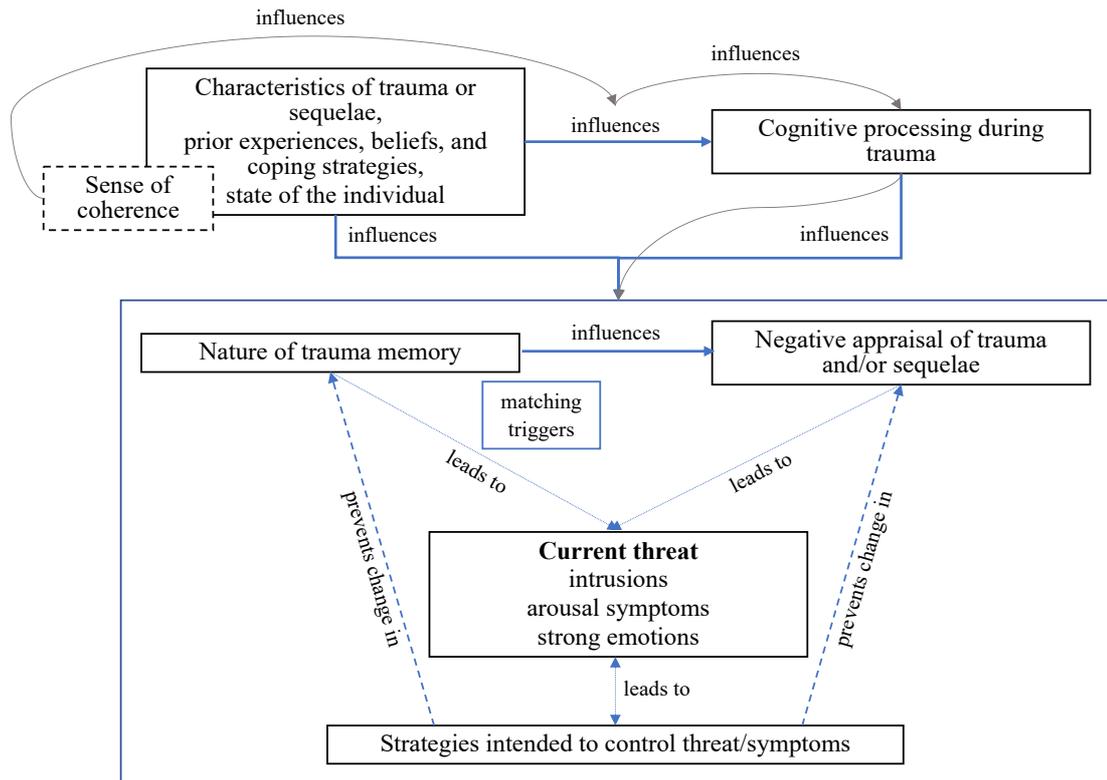
Figure 4. Sense of coherence and its potential impact in the cognitive model of PTSD by Ehlers and Clark (2000).

Studies using an analogue procedures like the trauma film paradigm (James et al., 2016) or traumatic picture stories (Sopp, Brueckner, Schäfer, Lass-Hennemann, & Michael, 2019) in healthy samples represent one potential way to connect these research fields. In an analogue study currently conducted in our group, SOC levels are assessed along with other potential protective and risk factors (e.g., psychophysiological markers, rumination, etc.) before individuals are exposed to a trauma film. The study aims to predict post-trauma memory-related symptoms (i.e., intrusion frequency and distress, explicit memory performance) based on pre-trauma protective and risk factors and also investigates cognitive appraisal processes. Such studies combining concepts usually assessed in field studies and methods of experimental psychopathology may provide further insights into the relationship between health-benefitting factors and PTSD symptom and could allow for stronger conclusions on temporal causality.

5.5.2 STUDYING RESILIENCE SYSTEMS

One aspect characterizing the studies included in this dissertation as well as most research into health-benefitting factors is their focus on specific relationships between different concepts (e.g., between SOC and PTSD symptoms as in *Study 1*). Thereby, most research fails to acknowledge the need to identify a holistic system that is relevant for adaptive responses to a stressor. Such a system may include more than one or two health-benefitting concepts as the driving factors as well as

contextual variables and resources (e.g., social support) that are used to cope with a stressor. Moreover, the latter may produce effects different in nature and size on psychopathological symptom levels over longer periods of time as it has been shown for social support (Wagner, Monson, & Hart, 2016). Similar or even equal outcomes (e.g., low levels of psychopathological symptoms) may originate from complex interactions of different components (Layne, 2019). However, by failing to define a comprehensive and exhaustive system, outcomes may be assessed but not causally explained. Hence, research may benefit from efforts to define and model those *systems*. For example, the theoretical framework of the salutogenesis model not only includes the frequently studied bivariate relationship between SOC and symptoms of psychopathology, but also several assumptions concerning (G)RR and factors that function as moderator or mediators of coping processes. However, these factors (highlighted in grey in Figure 5) have not been studied in most research into the salutogenesis framework (Mittelmark et al., 2017), leaving the proposed system understudied.
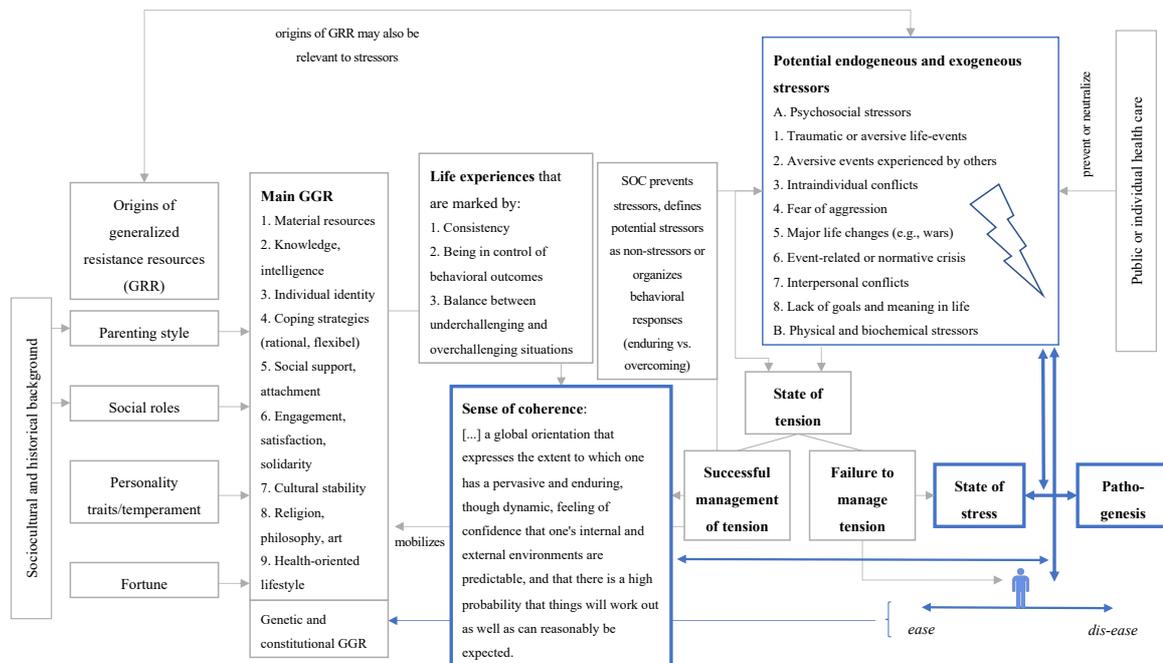

Figure 5. Revised illustration of the salutogenesis framework adapted and amended from Singer and Brähler (2007) and Antonovsky (1979). Grey parts represent proposed moderators and mediators, which have not yet been tested. Blue parts highlight frequently studied relationships.

Figure 5 illustrates that research mainly focused on specific parts/aspects of the salutogenesis model (highlighted in blue) - the association of SOC and mental health or measures of distress.

Moreover, the salutogenesis model (Antonovsky, 1979, 1987) is only one suggestion of a potential system that needs to be defined, operationalized, and subsequently tested. Thus, future research should put more effort into theory-based conceptualizations of complex systems that are relevant to coping processes. Building on these systems, studies should aim to identify causal

relationships between different components and identify moderating and mediating effects rather than re-analyzing specific components and associations of a much more complex system. Such studies might also allow for the development of secondary prevention interventions (Roberts et al., 2009), that target different components of the system in a beneficial way to lower the risk for the onset of stressor-related disorders.

5.6 CONCLUSION

The current dissertation aims to increase the conceptual clarity of health-benefitting factors associated with general mental health problems and/or PTSD symptoms following life stressors or traumatic experiences. A specific goal was to identify central health-benefitting correlates of psychopathological symptom levels and to estimate their unique associations with psychopathological symptom severity. Thereby, the thesis intended to investigate the overlap and potential redundancies between these different health-benefitting concepts.

The findings shed light on the relationships between different health-benefitting factors - namely, SOC, trait-resilience, LOC, hardiness, self-efficacy, sense of mastery, dispositional optimism, and openness to experience - and psychopathological symptoms in terms of general mental health problems and PTSD symptoms. All studies included in this thesis consistently identified SOC as a particular important correlate (*Studies 2, 3,* and *5*) or relevant predictor (*Studies 1* and *4*) of psychopathological symptom levels. Two field studies (*Studies 2* and *3*) investigating occupations at risk for traumatization demonstrated SOC's incremental validity beyond trait-resilience and (internal and external) LOC in predicting PTSD symptoms and general mental health problems. These findings were robust across different samples and high-risk occupations (i.e., medical staff, police officers, and firefighters). Moreover, SOC's role as a particular important correlate of mental health in different populations was further supported by a comprehensive meta-analytical investigation (*Study 5*), which contrasted the relationship between PTSD symptom levels and SOC with other health-benefitting factors. SOC was found to be the strongest correlate, *M(r)* = -.40, among these accounting for 16% of the variance in PTSD symptom levels. All other health-benefitting factors showed smaller associations with PTSD symptoms. Moreover, elaborating on the identified theoretical overlap between trait-resilience and hardiness as well as between (internal and external) LOC and sense of mastery, these factors were integrated in joint models. These revealed that neither the combination of trait-resilience and hardiness nor the integration of LOC and sense of mastery resulted in a significant increase of heterogeneity. The latter may constitute a health-benefitting control factor, while the former represents facets of trait-resilience, which among all health-benefitting factors lacks the most in conceptual clarity. Moreover, meta-analytical regression models supported the results of *Studies 2* and *3* by demonstrating that SOC exhibits the strongest unique association with PTSD symptoms rendering all other health-benefitting factors (i.e., trait-resilience/hardiness and LOC/sense of mastery) redundant.

Building on these findings, future research needs to focus on longitudinal studies into health-benefitting concepts, of which SOC may represent the most important and comprehensive. A field study conducted in a rehabilitation clinic (*Study 4*) provided first promising evidence that SOC levels might further represent a relevant predictor of symptom change and treatment outcomes. This should be studied in future research along with other health-benefitting factors using more homogeneous samples and interventions.

Most importantly, research into health-benefitting factors needs to shift towards the direction of more complex - and thus more extensive - study designs that not only monitor the course of symptoms over longer periods of time, but also assess health-benefitting factors more frequently. To date, research - especially into salutogenesis and SOC - is mainly limited to studies assessing health-benefitting factors once (or at the most twice) and only a small number of studies monitored symptom trajectories over longer periods of time. There is no further need for such studies, since two meta-analyses (*Studies 1* and *5*) robustly demonstrated a strong cross-sectional relationship between SOC and PTSD symptom levels. Hence, research has to shift to studies that allow for the monitoring of processes and mechanisms in order to explain the strong cross-sectional relationship that has been robustly identified in this dissertation project.

The studies constituting this thesis may build a foundation for future research on health-benefitting factors, and SOC in particular, that may allow for the development and improvement of treatment and prevention of stressor-related psychopathological symptoms. Eventually, interventions derived from this research may allow individuals to "*swim in the dangerous river of life*" (Antonovsky, 1996, p. 14).

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APPENDICES

APPENDIX A: RESULTS FROM THE ONLINE SURVEY - PEARSON CORRELATIONS BETWEEN SENSE OF COHERENCE AND OTHER HEALTH-BENEFITTING FACTORS

Table A.1. Pearson Correlations Between Sense of Coherence and Other Health-Benefitting Factors ($N = 94$)

	1	2	3	4	5	6	7	8	9	10	11	12	13
SOC (1)	—												
manageability (2)	0.80**	—											
comprehensibility (3)	0.91**	0.64**	—										
meaningfulness (4)	0.63**	0.23*	0.38**	—									
Trait-resilience (5)	0.68**	0.47**	0.56**	0.57**	—								
Internal LOC (6)	0.44**	0.26*	0.35**	0.47**	0.47**	—							
External LOC (7)	-0.52**	-0.49**	-0.49**	-0.33*	-0.38**	-0.42**	—						
Self-efficacy (8)	0.41**	0.32*	0.33**	0.34**	0.65**	0.46**	-0.38**	—					
Sense of mastery (9)	0.80**	0.64**	0.73**	0.48**	0.56**	0.52**	-0.71**	0.47**	—				
Hardiness (10)	0.67**	0.39**	0.54**	0.66**	0.66**	0.47**	-0.51**	0.49**	0.64**	—			
Openness to experience (11)	-0.18	-0.10	-0.21*	-0.10	0.20	-0.10	-0.01	0.07	-0.11	0.12	—		
Dispositional optimism (12)	0.49**	0.36**	0.42**	0.39**	0.51**	0.34**	-0.28**	0.55**	0.51**	0.55**	-0.03	—	
General mental health problems (13)	-0.72**	-0.62**	-0.60**	-0.46**	-0.57**	-0.40**	0.47**	-0.47**	-0.67**	-0.53**	0.10	-0.50**	—

Note. SOC = sense of coherence, LOC = locus of control.
* $p < .05$, ** $p < .001$.

Abstract

Background. Hospitals, police stations, and fire departments are highly demanding workplaces.
Staff members are regularly exposed to various stressors including traumatic events. Correspondingly,
several studies report high rates of mental health issues among these occupations. Nevertheless, despite
these challenging circumstances, some staff members manage to sustain their mental health. The current
study is the first to investigate correlates of mental health among three different highly demanding
occupations.

Methods. The present cross-sectional survey investigated health-benefitting factors (sense of
coherence – SOC, trait resilience, locus of control – LOC) and psychopathological symptoms (general
mental health problems, posttraumatic stress, burnout) in medical staff (n = 223), police officers (n =
257), and firefighters (n = 100).

Results. Among all occupations, SOC, trait resilience, and an internal LOC were negatively
associated with general mental health problems, posttraumatic stress, and burnout symptoms. By
contrast, all these outcome measures were positively correlated with an external LOC. Multiple
regression models including all health-benefitting factors as predictors explained 56% of the variance
in general mental health problems and 27% in posttraumatic stress symptoms. Among all occupations,
SOC was the strongest predictor of both general mental health problems and posttraumatic stress
symptoms. Multigroup path analyses revealed minor differences across occupations, mainly driven by
a stronger influence of LOC in police officers.

Conclusion. Across all occupations, SOC was identified as the most important health-benefitting
factor. Future longitudinal studies should further examine the causal link between health-benefitting
factors and mental distress in different workplaces. Such studies will also allow for further development
and evaluation of resilience promoting programs.

Keywords: resilience, sense of coherence, salutogenesis, locus of control, posttraumatic stress,
burnout, occupation, police, firefighters, medical staff

Background

Some professions are not only exposed to considerable levels of occupational stress but are also at a high risk for experiencing traumatic events. While approximately 70% of the global civilian population report the experience of a traumatic event during their lifetime (Benjet et al., 2016; Liu et al., 2017), this statistic increases to 84% for individuals working in high-risk occupations [e.g., police officers, firefighters and emergency dispatchers; Patterson (2001)]. Critically, individuals working in these occupations are repeatedly exposed to work-related traumatic events resulting in a cumulative burden which, in turn, increases their risk of developing mental health problems (Geronazzo-Alman et al., 2017). Three commonly identified high-risk occupations are medical staff (Adriaenssens, Gucht, & Maes, 2015), police officers (Darensburg et al., 2006; Liberman et al., 2002), and firefighters (Jahnke, Poston, Haddock, & Murphy, 2016). Accordingly, various studies report increased rates of burnout and depression in medical staff (e.g., Cañadas-De la Fuente et al., 2015; Taylor, Graham, Potts, Richards, & Ramirez, 2005), especially in intensive care medicine (Mealer, 2016). In case of police officers, symptom severity of mental health problems seem to depend on specific contextual factors: while a comparative study in the Netherlands did not find increased rates of mental health problems in police officers (van der Velden et al., 2013), studies conducted in Austria (Lawson, Rodwell, & Noblet, 2012) and Sri Lanka (Wickramasinghe, Wijesinghe, Dharmaratne, & Agampodi, 2016) report higher rates of depression among police staff. However, the latter two lack a matched control group of other occupations with lower risks for traumatization and compare the prevalence rates to rates of the general population. Regarding firefighters, reported rates of posttraumatic stress disorder (PTSD) and other mental health problems differ considerably because of various applied cut-off scores and different (mostly self-report) instruments (Del Ben, Scotti, Chen, & Fortson, 2006). However, recent findings suggest high rates of mental health issues, including depression, PTSD, as well as substance abuse, and a linear relationship between the number of fatal incidents and the severity of mental health problems (Harvey et al., 2016).

However, responses to occupational and operational stressors vary among employees. While some individuals experience the described mental health problems, others are able to maintain their mental health even when faced with persisting stressful circumstances (e.g., Imani, Kermanshahi, Vanaki, & Kazemnejad Lili, 2018; Ogińska-Bulik & Kobylarczyk, 2016; Sollie, Kop, & Euwema, 2017). Based on these diverging responses to long-term stressors, it is crucial to identify factors and strategies that enable successful coping in highly demanding workplaces.

In this context, Aaron Antonovsky's theory of salutogenesis (1979, 1987) – with sense of coherence (SOC) as its key component – is closely linked to successful coping processes. SOC is defined as "a global orientation that expresses the extent to which one has a pervasive and enduring, though dynamic, feeling of confidence that one's internal and external environments are predictable, and that there is a high probability that things will work out as well as can reasonably be expected" [Antonovsky (1979), p. 10]. In line with this definition, SOC as a resistance factor is assumed to uniquely combine

behavioural, cognitive, and motivational aspects of coping and resistance (Mittelmark et al., 2017). With respect to work stressors, previous studies identify SOC as the most important correlate of mental health problems and posttraumatic stress in intensive care and anaesthesiology staff (Schäfer et al., 2018) and paramedics (Streb, Häller, & Michael, 2014). Moreover, recent meta-analyses underline SOC's role as a correlate of posttraumatic stress symptoms in various populations (Schäfer, Becker, King, Horsch, & Michael, 2019) and as a determinate of carer well-being in informal caregiving (del-Pino-Casado, Espinosa-Medina, López-Martínez, & Orgeta, 2019). Consequently, higher levels of SOC are associated with lower levels of psychopathological symptoms (Streb et al., 2014) and enhanced posttraumatic growth (Ragger, Hiebler-Ragger, Herzog, Kapfhammer, & Unterrainer, 2019) in medical staff. Similar associations of SOC and mental health problems have also been demonstrated for police officers (Dudek & Szymczak, 2011) and firefighters (Dudek & Koniarek, 2000).

Another concept considered to be important for maintaining mental health even under stressful circumstances is resilience (Agaibi & Wilson, 2005). However, specific conceptualizations of resilience differ: firstly, resilience can be defined as a (rather stable) personality trait that inoculates individuals against the negative impact of stressful life events (Hu, Zhang, & Wang, 2015). Secondly, resilience can be conceptualized as an outcome, i.e., as the absence of psychopathological symptoms after loss and potential trauma (Bonanno, 2004; Bonanno & Mancini, 2012). Furthermore, a third conceptualization of resilience as an active process of recovery following aversive life events has been increasingly employed in recent research (Southwick, Bonanno, Masten, Panter-Brick, & Yehuda, 2014). Overall, resilience can be broadly defined as the ability to adapt successfully in the face of adversity, trauma, tragedy or significant threat (Horn, Charney, & Feder, 2016).

When considering resilience as a personality trait, it is plausible to assume that it is involved in the process of coping by enabling an individual to adapt even in challenging situations, thereby contributing to a beneficial outcome in terms of fewer psychopathological symptoms. Considering related health-benefitting variables, trait resilience shows a substantial overlap with the concept of SOC: both SOC and trait resilience are assumed to initiate, modulate, and support successful coping processes. However, both concepts have rarely been studied in a joint model with most studies focusing on either SOC or trait resilience. In this regard, various studies concentrating on trait resilience have identified associations with fewer psychopathological symptoms in medical staff (e.g., Arrogante & Aparicio-Zaldivar, 2017; Mealer et al., 2012; Mealer, Schmiege, & Meek, 2016), police officers [McCanlies, Mnatsakanova, Andrew, Burchfiel, and Violanti (2014); van der Meulen, van der Velden, Setti, and van Veldhoven (2018); but see a conflicting study by Balmer, Pooley, and Cohen (2014)] as well as in firefighters (Jeong et al., 2015; Lee, Ahn, Jeong, Chae, & Choi, 2014).

Locus of control [LOC; Rotter (1966)] is another concept that is frequently discussed as a health-benefitting factor, which shows substantial conceptual overlap with both SOC and trait resilience. LOC assesses the degree to which individuals have the impression that events are controllable by their own actions (internal LOC) or predominantly depend on factors beyond their personal influence (external

LOC). Previous research has identified an external LOC as a risk factor of posttraumatic stress symptoms (Zhang, Liu, Jiang, Wu, & Tian, 2014), as a mediating factor between socioeconomic adversity and later depression (Culpin, Stapinski, Miles, Araya, & Joinson, 2015), and as a correlate of psychopathological symptoms (Gore, Griffin, & McNierney, 2016). On the other side, an internal LOC has been demonstrated to be a protective factor against the development of psychopathological symptoms in soldiers (Karstoft, Armour, Elklit, & Solomon, 2015) and in adolescents after an earthquake (Zhang et al., 2014). In contrast to SOC and trait resilience, LOC has not been extensively studied in different occupations. However, some studies identified LOC as an important correlate of various aspects of mental health in medical staff (Jennings, 1990; Kooranian, Khosravi, & Esmaeeli, 2008; Schmitz, Neumann, & Oppermann, 2000), police officers (Marmar et al., 2006), and firefighters (Brown, Mulhern, & Joseph, 2002; Regehr, Hill, & Glancy, 2000).

As illustrated by the presented evidence, there is a wealth of cross-sectional research on specific health-benefitting factors. However, few studies have investigated multiple health-benefitting factors simultaneously. Considering their high conceptual overlap, such research is needed in order to investigate their unique associations with psychopathological symptoms, and to identify the most important predictors and correlates of beneficial health outcomes. While some studies have already considered different concepts and their unique impact on mental health problems (e.g., Grevenstein, Aguilar-Raab, Schweitzer, & Bluemke, 2016; Schäfer et al., 2018; Streb et al., 2014), to our knowledge, none of these studies simultaneously assessed different high-risk occupations. One cross-sectional study that assessed social resources, including SOC, in multiple uniformed services (i.e., police officers, firefighters, prison officers, security guards, and city guards), focused their analyses around a general model of health and work stress rather than on group comparisons (Oginska-Bulik, 2005). Given this lack of research, the current study simultaneously assessed multiple health-benefitting factors (SOC, trait resilience, and LOC), as well as psychopathological symptoms (general mental health problems, posttraumatic stress symptoms, and burnout) in three high-risk occupations. The aim of the current study was to investigate the associations between health-benefitting factors and psychopathological symptoms in different occupations in order to examine their unique contributions to psychopathological symptoms. Critically, we aimed to determine whether different patterns of associations emerge for different occupations by applying multigroup path analyses.

Method

Sample recruitment

Participants were recruited online by contacting different organisations and interest groups that represent specific high-risk occupations. Specifically, we contacted trade unions for medical professions, police staff, and firefighters. Moreover, study advertisements were posted on webpages addressing members of high-risk occupations (e.g., Facebook groups sharing information on emergency care). Respondents were additionally asked to distribute the survey link at their individual workplaces.

Sample recruitment took place between February and November 2018. During this period, 750 individuals completed the 30-minute online survey. 170 respondents were excluded since they did not work in a field of interest. The final sample thus comprised 223 respondents who worked in the field of medicine, 257 police officers, and 100 firefighters. The study protocol was approved by the ethics committee of Saarland University (no. 16-2). All respondents gave written informed consent in accordance with the Declaration of Helsinki (World Medical Association, 2013).
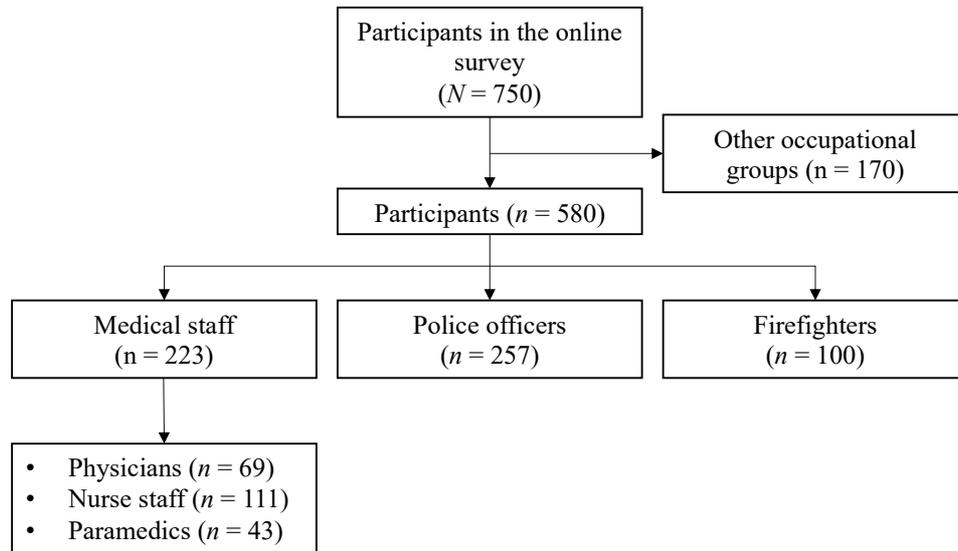
Figure 1. Flow chart of the study sample

Sample characteristics

Two hundred and thirty-five women (41%) and 345 men (59%) with a mean age of 38.19 years (SD = ±11.55 years) participated in the survey. Across different occupations, the respondents reported 16.68 years (± 11.54 years) of work experience. Sixty percent of respondents worked in shifts, with 51% working night and 20% working standby shifts.

Measures

Socio-demographic and occupational information. The survey started with 18 questions on socio-demographic characteristics (i.e., gender, marital status, etc.) and occupational information (e.g., type of profession, work experience). This was followed by a set of standardized questionnaires on respondents' current psychopathological symptom burden and health-benefitting factors.

Health-benefitting factors.

Sense of coherence. SOC was measured using two questionnaires. SOC as defined by Antonovsky (1979) was assessed using the German 13-item short version of the Antonovsky scales [SOC-13; Singer and Brähler (2007); English original scale: Antonovsky (1993)]. SOC-13 uses a bipolar seven-point scale with a verbal anchor on each side. Additionally, SOC-Revised (SOC-R) was assessed using a 13-item questionnaire developed by Bachem and Maercker (2016). In the current sample, SOC-13 showed

good internal consistency reflected in a Cronbach's alpha (α) of .84. Results of analyses focusing on SOC-R will be reported elsewhere.

Trait-resilience. The Resilience Scale 11 [RS-11; Schumacher, Leppert, Gunzelmann, Strauss, and Brähler (2005); English original scale: Wagnild and Young (1993)] assesses general psychological resilience as a trait that enables an individual to cope with stressful life events. RS-11 was developed as a short version of the 25-item resilience scale (Schumacher et al., 2005). All items are rated on a bipolar seven-point scale. In the current study its reliability was good with α = .90.

Locus of control. The concept of locus of control was assessed using the four-item brief scale for the assessment of control beliefs [IE-4; Kovaleva, Beierlein, Kemper, and Rammstedt (2012)]. This instrument consists of two subscales comprising two items each measuring perceived internal and external control. All items are rated on a five-point scale. As expected, items of each scale were correlated, $r_{internal}$ = .36, $r_{external}$ = .37, and both scales were negatively correlated, r = -.44.

Psychopathological symptom burden.

General psychopathological symptoms. General psychological symptom burden was assessed using the German version of the Brief Symptom Inventory [BSI; Franke (2000); English orginal: Derogatis (1992)]. The BSI is a 53-item self-report instrument that measures symptomatic distress using nine subscales. For this study, the global severity index (GSI) which indicates general psychopathological symptom burden was used. In the current study the GSI showed a good reliability as reflected in α = .96.

Posttraumatic stress symptoms. Posttraumatic stress was measured using the German version of the Impact of Event Scale-Revised [IES-R; Maercker and Schützwohl (1998)]; English original scale: Horowitz, Wilner, and Alvarez (1979)]. The IES-R assesses symptoms of intrusive re-experiencing, hyperarousal, and avoidance. The questionnaire consists of 22 items each rated on a four-point scale. Item scores are transformed into a non-equidistant format (0, 1, 3, 5) resulting in a minimum total score of 0 and a maximum total score of 110. In line with pervious findings (Maercker & Schützwohl, 1998), the IES-R showed good internal consistencies in the current sample for the total score (α = .93).

Burnout symptoms. The German version of the Maslach Burnout Inventory – General Survey [MBI; Büssing and Perrar (1992); English original scale: Maslach, Jackson, and Leiter (1996)] was used to assess burnout symptoms in different occupations. The MBI consists of 22 items assessing three domains of burnout: emotional exhaustion (EE), depersonalization (DP), and personal accomplishment (PA). All items are rated on a seven-point scale. Psychometric properties of the scale have been shown to be sufficient (Schutte, Toppinen, Kalimo, & Schaufeli, 2000) and were also satisfactory in the current sample reflected in high internal consistencies for all subscales (α_{EE} = .90, α_{DP} = .75, α_{PA} = .75).

Data collection and analyses

All measures were collected using the online survey platform SoSci Survey (Leiner, 2014). Analyses were conducted using SPSS version 25 (IBM Corp, 2017), RStudio (R Development Core Team, 2017) and the lavaan package (Rosseel, 2012).

Descriptive statistics were computed to illustrate sample characteristics in the terms of frequencies, means (*M*), and standard deviations (*SD*) of the variables. To assess differences between different occupations, MANOVAs and *t*-tests for independent samples were conducted. Bonferroni-Holm's correction (Holm, 1979) was applied to control for the effects of multiple testing. Pearson's bivariate correlation coefficients were used to assess the relationship between SOC, trait resilience, LOC, and health outcomes. Multiple regressions were conducted to determine the unique variance explained by each predictor variable that showed a significant bivariate correlation with the respective outcome variable. To assess the specific relevance of each predictor, multiple hierarchical regressions were conducted including each variable in the last step. The change in R^2 (ΔR^2) represents the unique amount of variance accounted for by each predictor. ΔF was used to assess the significance of ΔR^2. Due to missing data, degrees of freedom vary between analyses. Path analyses were conducted to compare multiple regression models among different occupations. Regression models were calculated as saturated models (*df* = 0) allowing for varying path coefficients across occupations and were compared with a model constraining all regression coefficients across occupations to be equal. Differences in model fit were assessed using $\Delta \chi^2$-tests. A significant $\Delta \chi^2$-test indicates significant group differences concerning the regression model. In this case, further model tests were conducted to identify paths that varied significantly across occupations. Significant differences between regression coefficients were tested using *z*-tests as previous done by Arble, Daugherty and Arnetz (2018).

Results

Demographic group differences

Sample characteristics of each occupation are presented in Table 1. Occupations differed regarding the proportion of women, $\chi^2(2) = 129.88$, $p < .001$. Police officers and firefighters included predominately male participants whereas the medical staff group comprised more women. Occupational groups also differed in mean age, $F(2, 574) = 6.37$, $p = .002$, $\eta^2 = .02$. After applying Bonferroni-Holm's correction, post-hoc tests revealed that police officers were significantly older than medical staff, $t(457) = -2.84$, $p_{adjusted} = .010$, $d = 0.27$, and firefighters, $t(345) = 3.06$, $p_{adjusted} = .006$, $d = 0.33$. There was no difference between medical staff and firefighters, $t(319) = 0.79$, $p = .431$, $d = 0.09$. Moreover, occupations differed significantly regarding their years of work experience, $F(2, 574) = 25.42$, $p < .001$, $\eta^2 = .09$. Post-hoc tests revealed that medical staff reported significantly fewer years of work experience than police officers and firefighters, $t(543) = -6.06$, $p_{adjusted} < .001$, $d = 0.52$. However, there was no difference between police officers and firefighters, $t(543) = 1.93$, $p = .054$, $d = 0.17$. Shift work was more common in medical staff and police officers than in firefighters, $\chi^2(2) = 60.11$, $p < .001$. Of those

working shifts, especially police officers reported an increased number of night shifts, $\chi^2(2) = 23.26$, $p < .001$. Standby shifts were most frequent in medical staff compared to lower rates in police officers and firefighters, $\chi^2(2) = 38.94$, $p < .001$.

Table 1. Sample characteristics per occupational group

	Medical staff	Police officers	Firefighters		p
Sex (% women)	68.61	28.40	9.00	$\chi^2(2) = 129.88$	< .001
Age (in years)	37.05 (11.64)	40.05 (11.35)	35.96 (11.26)	$F(2, 574) = 6.37$	.002
Job experience (in years)	12.34 (9.69)	19.82 (11.98)	17.29 (11.16)	$F(2, 574) = 25.42$	< .001
Shift work (%)	74.00	64.20	26.00	$\chi^2(2) = 60.11$	< .001
Night shifts (% of those working shifts)	76.43	93.93	69.20	$\chi^2(2) = 23.26$	< .001
Standby duty (%)	49.68	16.70	34.62	$\chi^2(2) = 38.94$	< .001

Group differences: Psychopathological symptoms

General psychopathological symptoms. An ANOVA with occupation as between-subject factor and GSI scores as dependent variable showed no significant group differences regarding psychopathological symptom burden, $F(2, 568) = 0.79$, $p = .455$, $\eta^2 = .00$.

Posttraumatic-stress symptoms. An ANOVA with occupation as between-subject factor and IES-R total scores as dependent variable revealed no significant group differences, $F(2, 495) = 2.31$, $p = .101$, $\eta^2 = .01$.

Burnout symptoms. A MANOVA with occupation as between-subject factor and MBI-subscale scores as dependent variables revealed significant group differences, $F(6, 1134) = 9.89$, $p < .001$, $\eta^2 = .05$. Univariate comparisons, yielded significant differences for each subscale; emotional exhaustion: $F(2, 568) = 15.27$, $p_{adjusted} < .001$ $\eta^2 = .05$; depersonalization: $F(2, 568) = 13.97$, $p_{adjusted} < .001$, $\eta^2 = .05$; personal accomplishment: $F(2, 568) = 4.98$, $p = .007$, $\eta^2 = .02$. Post-hoc tests revealed that police officers reported higher levels of emotional exhaustion than medical staff, $t(573) = 5.06$, $p_{adjusted} < .001$, $d = 0.42$, and that emotional exhaustion was higher in medical staff than in firefighters, $t(573) = -3.50$, $p_{adjusted} < .001$, $d = -0.29$. Moreover, police officers showed significantly higher rates of depersonalization compared to both other groups, $t(574) = 5.10$, $p_{adjusted} < .001$, $d = 0.43$, while medical staff and firefighters did not differ, $t(574) = -.14$, $p = .887$, $d = -0.01$. Concerning personal accomplishment, medical staff showed higher rates than both other groups, $t(569) = 3.14$, $p_{adjusted} = .004$, $d = 0.26$, while police officers and firefighters reported comparable levels, $t(569) = 0.30$, $p = .765$, $d = 0.03$.

Table 2. Means, standard deviations and group differences of health outcomes and health-benefitting factors

	Medical staff (MS)	Police officers (PO)	Fire-fighters (FF)		p	Significant post-hoc tests
Health outcomes						
General mental health problems	15.37 (5.41)	15.91 (5.29)	15.24 (6.38)	$F(2, 568) =$ 0.79	.455	
Posttraumatic stress symptoms	29.67 (22.49)	30.31 (23.36)	24.58 (19.29)	$F(2, 495) =$ 2.31	.101	
Burnout						
Emotional exhaustion	16.54 (10.35)	18.99 (11.17)	12.01 (10.10)	$F(2, 573) =$ 15.26,	< **.001**	PO > MS > FF
Depersonalization	6.68 (5.95)	9.36 (6.44)	6.57 (5.88)	$F(2, 574) =$ 13.80	< **.001**	PO > (MS = FF)
Personal accomplishment	30.21 (7.69)	28.06 (8.51)	27.77 (7.93)	$F(2, 569) =$ 5.15	**.006**	MS > (PO = FF)
Health-benefitting factors						
Sense of coherence	46.58 (7.59)	45.11 (7.52)	46.84 (7.84)	$F(2, 577) =$ 3.02	**.050**	PO < (MS = FF)
Trait resilience	60.94 (10.14)	60.98 (10.18)	60.02 (9.69)	$F(2, 575) =$ 0.36	.700	
Internal LOC	4.14 (0.62)	3.94 (0.72)	4.18 (0.61)	$F(2, 577) =$ 7.05	**.001**	PO < (MS = FF)
External LOC	2.40 (0.77)	2.61 (0.82)	2.34 (0.82)	$F(2, 577) =$ 5.61	**.004**	PO > (MS = FF)

Note. Significant group differences are bold.
FF = firefighters; LOC = Locus of control; MS = Medical staff; PO = police officers.

Group differences: Health-benefitting factors

Sense of coherence. An ANOVA with occupation as between-subject factor and SOC scores as dependent variable revealed marginally significant between-group differences, $F(2, 577) = 3.02$, $p = .050$, $\eta^2 = .010$. Compared to both other groups, police officers showed significantly lower SOC levels, $t(577) = -2.43$, $p_{adjusted} = .030$, $d = -0.20$, while medical staff and firefighters reported comparable SOC levels, $t(577) = -0.29$, $p = .775$, $d = -.02$.

Trait resilience. In an ANOVA with occupation as between-subject factor and trait resilience levels as dependent variable, no group differences were found, $F(2, 575) = 0.36$, $p = .700$, $\eta^2 = .00$.

Locus of control. A MANOVA with occupation as between-subject factor and internal and external LOC scores as dependent variables revealed significant group differences, $F(4, 1154) = 4.38$, $p = .002$, $\eta^2 = .02$. Univariate comparisons showed that police officers reported significantly lower internal control beliefs, $t(577) = -3.72$, $p_{adjusted} < .001$, $d = -0.31$, whereas medical staff and firefighters did not differ significantly, $t(577) = -.051$, $p = .611$, $d = 0.00$. Correspondingly, external control beliefs were

significantly higher in police officers, $t(577) = 3.34$, $p_{adjusted} = .002$, $d = 0.28$, while both other groups did not differ, $t(577) = 0.58$, $p = .560$, $d = .05$.

Bivariate correlations

Table 3 shows the bivariate correlations between health-benefitting factors and different measures of psychopathological symptom burden. All health-benefitting factors were significantly correlated with mental health outcomes (all $ps < .001$). The strongest association was found between SOC and general psychopathological symptom burden, $r = -.73$, $p < .001$, indicating that a stronger SOC was related to lower symptom levels. As hypothesized, higher levels of SOC, resilience, and a stronger internal LOC were related to less severe general mental health problems, lower levels of posttraumatic stress, and fewer burnout symptoms. Conversely, stronger external control beliefs were linked to more severe general mental health problems, higher levels of posttraumatic stress, and more burnout symptoms.

Table 3. Bivariate Pearson correlations of health-benefitting factors and psychopathological symptoms

	1	2	3	4	5	6	7	8	9
SOC (1)	.84	.54**	.50**	-.53**	-.73**	-.49**	-.59**	-.44**	.42**
Resilience (2)		.90	.45**	-.31**	-.52**	-.34**	-.40**	-.23**	.48**
LOC$_{internal}$ (3)			.36	-.44**	-.38**	-.35**	-.42**	-.24**	.33**
LOC$_{external}$ (4)				.37	.43**	.38**	.41**	.24**	-.18**
GSI (5)					.96	.53**	.59**	.37**	-.32**
IES-R$_{total}$ (6)						.93	.45**	.27**	-.30**
MBI$_{EE}$ (7)							.90	.58**	-.25**
MBI$_{DP}$ (8)								.75	-.20**
MBI$_{PA}$ (9)									.75

Note. The diagonal shows the reliabilities (Cronbach's α).
** $p < .001$
SOC = Sense of coherence; LOC = Locus of control; GSI = Global Severity Index as measured by the Brief Symptom Inventory; IES-R = Impact of Event Scale-Revised; MBI = Maslach Burnout Inventory; MBI$_{EE}$ = MBI Emotional exhaustion; MBI$_{DP}$ = MBI Depersonalization; MBI$_{PA}$ = MBI Personal accomplishment.

Regression models

General psychopathological symptoms. A multiple regression showed that 56% of general mental health problems were explained by SOC, trait resilience, and internal and external control beliefs, $F(4, 566) = 179.30$, $p < .001$. All predictors except for internal control beliefs, $\beta = .05$, $t(566) = 1.33$, $\Delta R^2 = .00$, accounted for a unique amount of variance in symptom severity [SOC, $\beta = -.61$, $t(566) = -16.10$, $\Delta R^2 = .20$, $p < .001$, trait resilience, $\beta = -.19$, $t(565) = -5.57$, $\Delta R^2 = .02$, $p < .001$, external control beliefs, $\beta = .07$, $t(565) = 2.16$, $\Delta R^2 = .00$, $p = .031$].

Posttraumatic-stress symptoms. Regarding posttraumatic stress, 27% of variance in symptom severity could be collectively explained by the set of health-benefitting factors, $F(4, 493) = 45.18$, $p <$

.001. However, only SOC, $\beta = -.33$, $t(493) = -6.13$, $\Delta R^2 = .06$, $p < .001$, and an external LOC, $\beta = .15$, $t(493) = 3.20$, $p = .001$, $\Delta R^2 = .02$, accounted for unique amounts of variance.

Burnout symptoms. Together, SOC, trait resilience, and LOC explained 38% of the variance of symptoms of emotional exhaustion, $F(4, 571) = 88.19$, $p < .001$. On a single predictor level, all variables were significant predictors of emotional exhaustion, with SOC being the strongest, $\beta = -.43$, $t(571) = -9.63$, $\Delta R^2 = .10$, $p < .001$, followed by internal LOC, $\beta = -.12$, $t(571) = -2.98$, $\Delta R^2 = .01$, $p = .003$, external LOC, $\beta = .10$, $t(571) = 2.58$, $\Delta R^2 = .01$, $p = .005$, and trait resilience, $\beta = -.09$, $t(571) = -2.16$, $\Delta R^2 = .01$, $p = .003$. Regarding depersonalization, only 19% of the variance were explained by all predictors, $F(4, 572) = 33.70$, $p < .001$, whilst only SOC accounted for an unique amount of variance, $\beta = -.42$, $t(572) = -8.31$, $\Delta R^2 = .10$, $p < .001$. Concerning personal accomplishment, the set of predictors accounted for 28% of the variance, $F(4, 567) = 53.79$, $p < .001$. Trait resilience was the strongest predictor, $\beta = .43$, $t(567) = 7.84$, $\Delta R^2 = .08$, $p < .001$, followed by SOC, $\beta = .23$, $t(567) = 4.70$, $\Delta R^2 = .03$, $p < .001$, internal LOC, $\beta = .10$, $t(567) = 2.27$, $\Delta R^2 = .01$, $p = .024$, and external LOC, $\beta = .09$, $t(567) = 2.02$, $\Delta R^2 = .01$, $p = .045$. See Appendix A for a table presenting all regression results.

Group differences: Health-benefitting factors

General psychopathological symptoms. Comparing two models predicting general mental health problems based on SOC, trait resilience, internal, and external LOC allowing the regression coefficients to vary across groups or not, had no impact on the model fit, $\Delta\chi^2(8) = 12.91$, $p = .115$, indicating no differences between the occupations regarding the prediction of general mental health problems.

Posttraumatic-stress symptoms. Applying the same model comparison to posttraumatic stress, the test revealed a significant difference between models, $\Delta\chi^2(8) = 22.15$, $p < .001$. Model comparisons between models fixing regression coefficients across all groups and models allowing one path to vary across groups, revealed significant fit differences for external LOC, $\Delta\chi^2(2) = 9.25$, $p = .001$ (see Table 4 for all paths). Regarding regression coefficients, SOC descriptively remained the strongest predictor of posttraumatic stress for all occupations (see Table 5). However, external control beliefs explained a larger amount of variance in posttraumatic stress symptoms in police officers compared to firefighters, $diff = .31$, $p_{adjusted} < .001$, and medical staff, $diff = .21$, $p_{adjusted} < .001$, but there was no difference between medical staff and firefighters, $diff = .10$, $p = .111$, where external control beliefs were no longer a significant predictor of posttraumatic stress symptoms.

Burnout symptoms. Concerning burnout symptoms, the model comparison indicated significant differences across the different occupations regarding emotional exhaustion, $\Delta\chi^2(8) = 17.40$, $p = .026$, and personal accomplishment, $\Delta\chi^2(8) = 28.92$, $p < .001$, but no differences for depersonalization, $\Delta\chi^2(8) = 7.31$, $p = .504$. Concerning emotional exhaustion, model comparisons did not reveal significant fit differences for models allowing one path to vary across groups. Regarding personal accomplishment, model comparisons presented in Table 4 showed significant fit differences between a model fixing all regression coefficients and a model allowing one path to differ across groups for each predictor variable.

However, comparing the regression coefficients between the occupations, there was only one significant difference reflected in a larger association of SOC and personal accomplishment in medical staff than in firefighters, $diff$ = .05, $p_{adjusted}$ = .021.

Table 4. Fit differences between models fixing all regression coefficients across groups and models allowing one path to vary across groups

Outcome	Model comparisons
Posttraumatic stress	
Sense of coherence	$\Delta\chi^2(2) = 5.67, p = .059$
Trait resilience	$\Delta\chi^2(2) = 4.55, p = .103$
Internal LOC	$\Delta\chi^2(2) = 2.18, p = .337$
External LOC	$\Delta\chi^2(2) = 9.25, p = \mathbf{.001}$
Burnout	
Emotional exhaustion	
Sense of coherence	$\Delta\chi^2(2) = 1.20, p = .548$
Trait resilience	$\Delta\chi^2(2) = 4.41, p = .111$
Internal LOC	$\Delta\chi^2(2) = 2.84, p = .242$
External LOC	$\Delta\chi^2(2) = 0.95, p = .620$
Personal accomplishment	
Sense of coherence	$\Delta\chi^2(2) = 6.34, p = \mathbf{.042}$
Trait resilience	$\Delta\chi^2(2) = 17.72, p < \mathbf{.001}$
Internal LOC	$\Delta\chi^2(2) = 10.53, p = \mathbf{.005}$
External LOC	$\Delta\chi^2(2) = 10.05, p = \mathbf{.007}$

Note. Significant group differences are **bold**. LOC = Locus of control.

Table 5. Differences of path analyses between occupations

	Medical staff	Police officers	Fire-fighters	|diff 1|	$p_{adjusted}$	|diff 2|	$p_{adjusted}$	|diff 3|	P
General mental health									
Sense of coherence	**-.68**	**-.49**	**-.68**						
Trait resilience	**-.12**	**-.25**	**-.26**						
Internal LOC	.08	.04	.02						
External LOC	.02	**.05**	.05						
Posttraumatic stress									
Sense of coherence	**-.24**	**-.36**	**-.44**	.20	.174				
Trait resilience	.01	**-.15**	.06	.21					
Internal LOC	-.14	.06	**-.25**	.31					
External LOC	.07	**.28**	-.03	.31	*< .001*	.21	*< .001*	.10	.111
Burnout									
Emotional exhaustion									
Sense of coherence	**-.57**	**-.28**	**-.36**	.29					
Trait resilience	-.02	**-.25**	-.04	.23					
Internal LOC	-.04	-.10	**-.27**	.23					
External LOC	.02	**.15**	.11	.09					
Depersonalization									
Sense of coherence	**-.43**	**-.43**	**-.39**						
Trait resilience	-.04	-.03	.13						
Internal LOC	.09	-.06	-.10						
External LOC	-.06	-.04	.10						

Table 5 (continued).

Personal accomplishment							
Sense of coherence	**-.44**	**-.43**	**-.39**	.05	*.021*	.04	.082
Trait resilience	-.04	-.03	.13	.17	.100		
Internal LOC	.09	-.06	-.10	.19	.099		
External LOC	-.06	-.04	.09	.15	.840		

Note. Unstandardized coefficients are reported as estimated in the grouped path analysis. Significant regression coefficients in each group model are bolded ($p < .05$). Differences between medical staff, police officers and firefighters are italicized for emphasis. *p*-values are adjusted using Bonferroni-Holm's correction. Regression coefficients are grey if the model comparison in Table 4 did not indicate significant group differences.
diff 1 = Largest difference between regression coefficients that could be calculated. *diff* 2 = Second largest difference. *diff* 3 = Remaining comparison. LOC = Locus of control.

Discussion

For the first time, the current study assessed multiple health-benefitting factors and their associations with psychopathological outcomes across different high-risk occupations, that is, medical staff, police officers, and firefighters. SOC was identified as the most important correlate of mental health problems across different occupations. While all health-benefitting factors were found to collectively explain 56% of the variance in general mental health problems and 27% of the differences in posttraumatic-stress, SOC emerged as the strongest predictor for both outcome variables, accounting for 20% of variance in general mental health problems and 6% in posttraumatic stress symptoms. SOC was also the strongest predictor of the burnout subscales of emotional exhaustion and depersonalization symptoms and explained an equal amount of variance as trait resilience in personal accomplishment scores. Moreover, path analyses investigating group differences in the regression models, did not reveal differences for general mental health problems, but found significant differences between occupations for posttraumatic stress and burnout symptoms (except for depersonalization).

The current findings are in line with previous research that identified SOC as an important correlate of mental health problems across different occupations (e.g., Grevenstein et al., 2016; Oginska-Bulik, 2005; Schäfer et al., 2019; Streb et al., 2014). Comparing different health-benefitting factors, SOC's particularly strong association with several mental health outcomes may result from its conceptualization as the most comprehensive resistance factor, uniquely combining cognitive, motivational, and behavioral aspects that are essential in dealing with various stressors (Mittelmark et al., 2017). However, other aspects might also be of interest: In contrast to previous findings from our group (Schäfer et al., 2018; Streb et al., 2014), trait resilience as well as internal and external control beliefs also accounted for significant amounts of variance in general mental health problems and posttraumatic stress. Nonetheless, in terms of effect sizes, SOC remained the strongest correlate of health outcomes. The significant associations with trait resilience and control beliefs might thus be driven by the large sample in our study [but see Streb et al. (2014) with $N = 668$ paramedics], which also allowed for the identification of smaller predictors. However, despite SOC's role as an important correlate of mental health, its vague conceptual boundaries have been debated (Bachem & Maercker,

2016). SOC's strong correlations with other constructs, including depression, anxiety, and neuroticism, challenge its role as an independent concept (Geyer, 1997; Gruszczynska, 2006) as they suggest that SOC might constitute an inverse measure of psychopathology. However, there is no substantial overlap in item content between the SOC scales (Antonovsky, 1993) and standard measures of depression or anxiety. Furthermore, SOC increases over time and is found to be particularly strong in older adults (Eriksson & Lindström, 2006; Mittelmark et al., 2017), whereas the exact inverse course was not observed for measures of mental health issues (Westerhof & Keyes, 2010). Thus, reducing SOC to an inverse measure of psychopathology seems inappropriate. Irrespective of their overlap with other measures, the SOC scales developed by Antonovsky (1993) seem to provide an efficient way of assessing different health-benefitting aspects that show a substantial and robust association with various aspects of mental health.

With respect to group differences, path analyses did not identify differences between the occupations for general mental health problems, which in turn showed the strongest association with the investigated health-benefitting factors. In contrast, the predictors accounted for differential amounts of variance per group for posttraumatic stress. Across all occupations SOC remained the strongest predictor of posttraumatic stress. Interestingly, within the police group as opposed to medical staff and firefighters, an external LOC was found to be a significant and strong predictor for posttraumatic stress. Coincidentally, police officers reported significantly higher levels of an external LOC and significantly lower levels of internal control beliefs and SOC, suggesting an important role of control beliefs in police officers. In line with these findings, prior studies investigating LOC in police staff reported an association of external control beliefs and perceived levels of stress (e.g., Brown, Cooper, & Kirkcaldy, 1996; Lester, 1982). Moreover, a recent cross-sectional study by Arble, Daugherty and Arnetz (2018) investigated approach- and avoidance-based coping strategies in Swedish police officers and other non-military first responders. In accordance with the current findings, they mainly report similarities in coping processes and well-being across different first responders. However, avoidant coping, which describes strategies to avoid direct considerations of emotions and thoughts as well as triggering stimuli related to stressful events, was particularly relevant in police officers. Such coping strategies showed a stronger association with poor well-being and less posttraumatic growth in police officers than in other first responders. In line, a recent study reported a positive association of passive coping strategies and PTSD symptoms (Violanti et al., 2018). The current study identified control beliefs as an important correlate of PTSD symptoms, particularly in police officers. Thus, further studies in different occupations should investigate the relationship between control beliefs and avoidant coping, which may be caused by stronger external and weaker internal control beliefs, and might act as a mediator between control beliefs and psychopathological symptoms as shown previously in firefighters (Brown et al., 2002). However, given the cross-sectional nature of both studies, these findings do not address if individuals with low levels of internal and high levels of external control beliefs and avoidant coping strategies tend to choose a career in the police or if specific occupational and operational stressors during

police work impact on control beliefs. Furthermore, differences in personality between high-risk occupations, as they have been shown between police officers and firefighters (Salters-Pedneault, Ruef, & Orr, 2010), may impact both the choice of occupation and responses to stressors. As the directionality of this association is of critical relevance for potential interventions targeted at the promotion of health-benefitting factors in occupations at risk for mental distress, longitudinal studies are urgently required. Further, these studies should also focus on stressors that are specifically relevant to individual occupations, which might influence the differential relevance of health-benefitting factors between these occupations.

While general mental health problems and posttraumatic stress clearly showed the strongest association with SOC, burnout symptoms, which have not been addressed in prior studies (Oginska-Bulik, 2005; Schäfer et al., 2018; Streb et al., 2014), demonstrated a more diverse pattern of associations across different burnout symptom clusters. Depersonalization and emotional exhaustion, which showed the strongest correlations with psychopathological symptoms, were mainly predicted by SOC. However, trait resilience was the strongest predictor of personal accomplishment. Our findings are in line with prior studies that have already identified strong associations between SOC and burnout especially in medical staff (Levert, Lucas, & Ortlepp, 2000; Tselebis, Moulou, & Ilias, 2001; Van der Colff & Rothmann, 2009), between trait resilience and burnout (Arrogante & Aparicio-Zaldivar, 2017; Gito, Ihara, & Ogata, 2013; Hao, Hong, Xu, Zhou, & Xie, 2015), as well as between control beliefs and burnout (Kooranian et al., 2008; Schmitz et al., 2000). Moreover, as opposed to general mental health problems and posttraumatic stress, occupations differed regarding burnout symptoms. In line with previous studies that described a distinct pattern of results for police staff (Arble et al., 2018), this study found medical staff and firefighters to report lower levels of burnout symptoms. Together these findings indicate the presence of particular strain within the police [Adams, Hough, Proeschold-Bell, Yao, and Kolkin (2017); Basinska and Wiciak (2012); Johnson et al. (2005); but see: van der Velden et al. (2013)]. However, given that the current data constitute the first investigation of burnout symptoms within the context of multiple health-benefitting factors across different occupations in a large sample, results should be interpreted with caution. Particularly considering that some studies identified problems with the factorial validity of the MBI scales specifically in heavily burdened populations (Beckstead, 2002; Trigo et al., 2018).

Limitations

The present study has several limitations: firstly, our findings show that SOC, trait resilience, and LOC are correlates of psychopathological symptoms. However, no causal conclusions can be drawn from the current study: on the one hand, it is plausible to assume that these factors might play an important role in the development and course of mental health problems. On the other hand, the results might equally reflect that SOC, trait resilience, and an internal LOC are impaired by current mental health problems and posttraumatic stress. Also, a third variable might underlie the relationship between

health-benefitting factors and psychopathological symptoms. Thus, only longitudinal studies in large samples will give insight into the causal influence of health-benefitting factors on psychopathological symptoms and their development. Such studies may also assess a wider range of health-benefitting factors (e.g., openness, optimism, self-efficacy, and sense of mastery) and include a broader assessment of health including physical aspects.

Secondly, the present study did not assess occupational stressors. As these stressors are assumed to influence both health-benefitting factors and levels of psychopathological symptoms, future studies should include respective measures. In order to assess a large sample size across different occupations, we limited the number of measures to ensure that survey participation was not too time consuming. However, future research should consider assessing both occupational and operational stressors.

Future research

The majority of studies on mental health problems in different occupations is cross-sectional in design, limited to specific aspects of health and investigates only a small set of health-benefitting factors (Luthar, 2015). Future research should address these shortcomings by including multiple health-benefitting factors in order to further identify, both their unique association with several health outcomes and their overlapping aspects. Consequently, some of the discussed factors may become subordinate as they might only explain minor proportions of redundant variance. Furthermore, such studies should also include posttraumatic growth as an outcome measure as it has been shown to be associated with both health-benefitting factors (Ragger et al., 2019) and psychopathological symptoms (Shakespeare-Finch & Lurie-Beck, 2014). Moreover, there is a strong need for longitudinal studies addressing the predictive value of several health-benefitting factors across longer periods of time. A further shortcoming of current research is that some of the very rare longitudinal studies only assess health-benefitting factors after prior exposure to several stressors. This may have already impaired health-benefitting factors which might influence their assessment (de Looff, Didden, Embregts, & Nijman, 2018; Mc Gee, Höltge, Maercker, & Thoma, 2018). Future large-scale studies should assess health-benefitting factors as early as possible and more than twice to identify their causal influence on emerging psychopathological symptom burden. Such studies may also allow for further development and evaluation of resilience promoting programs, which have shown to be effective also in non-clinical samples (Macedo et al., 2014).

Conclusions

The current study is the first to address the association of psychopathological symptoms and various health-benefitting factors across different high-risk occupations (medical staff, police officers, and firefighters). Across all occupations, sense of coherence was the strongest correlate of general mental health problems, posttraumatic stress and burnout symptoms. Furthermore, burnout symptoms were strongly correlated with trait resilience. Overall, predictors of mental health problems were similar

across occupations. However, in contrast to medical staff and firefighters, external control beliefs explained a unique amount of variance in police officers in both general mental health problems and posttraumatic stress suggesting an important role of control beliefs in police officers.

Abbreviations

BSI: Brief Symptom Inventory; FF: firefighters; GSI: Global Severity Index as measured by the Brief Symptom Inventory; IES-R: Impact of Event Scale-Revised; IE-4: A four-item brief scale for the assessment of control beliefs; LOC: locus of control; MBI: Maslach Burnout Inventory; MBIDP: MBI Depersonalization; MBIEE: MBI Emotional exhaustion; MBIPA: Personal accomplishment; MS: medical staff; PO: police officers; PTSD: posttraumatic stress disorder; SOC: sense of coherence; SOC-R: SOC-Revised; RS-11: Resilience Scale 11

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APPENDIX C - STUDY 4

Abstract

Background. Sense of coherence (SOC) constitutes the key component of salutogenesis theory. It reflects individuals' confidence that their environment is comprehensible and manageable and that their lives are meaningful. Research demonstrates a strong cross-sectional relationship between SOC and mental health. However, little is known about SOC's temporal stability and its potential to predict treatment outcomes in psychotherapy. The goal of the current study was to address this gap.

Method. The study sample of the two-wave longitudinal study consists of 294 patients receiving inpatient psychotherapeutic (and psychopharmacological) treatment for various psychological disorders at a German psychosomatic rehabilitation clinic. SOC and outcome measures (i.e., general mental health problems, depression and anxiety symptoms) were assessed within two days of arrival and at the end of rehabilitation (week 5/6).

Results. SOC was significantly enhanced after treatment whereas psychopathological symptoms were significantly reduced. Regression analyses revealed that pre-treatment SOC was a significant negative predictor of post-treatment symptom severity for all outcome measures even when controlling for pre-treatment symptoms.

Conclusion. The current findings provide first evidence that SOC is a unique predictor of treatment outcomes. Future studies need to investigate longitudinal associations between SOC and mental health outcomes in different settings.

Keywords: sense of coherence, salutogenesis, depression, anxiety, rehabilitation, longitudinal study

Introduction

Sense of coherence (SOC) is the key component of Antonovsky's theory (1979, 1987) of salutogenesis. SOC is defined as a global orientation in life that "expresses the extent to which one has a pervasive, enduring though dynamic feeling of confidence that one's internal and external environments are predictable and that there is a high probability that things will work out as well as can reasonably be expected" (Antonovsky, 1979, p. 10). Individuals with high levels of SOC perceive their environment as comprehensible and manageable and believe that their lives are meaningful.

SOC has been identified as a powerful correlate of mental health (Eriksson & Lindström, 2006), whereas its association with physical health is weaker and less consistently found (Eriksson & Lindström, 2006; Flensborg-Madsen, Ventegodt, & Merrick, 2005). Recent meta-analyses show that a stronger SOC is related to lower levels of psychopathological symptoms in traumatized individuals (Schäfer, Becker, King, Horsch, & Michael, 2019) and informal caregiving (del-Pino-Casado, Espinosa-Medina, López-Martínez, & Orgeta, 2019).

However, on a conceptual level, SOC's strong correlations with psychopathological symptoms [e.g., $r = -.75$ for depression (Flannery & Flannery, 1990)] challenge its role as an independent construct (Bachem & Maercker, 2016). Indeed, it has been suggested that SOC, as measured by the Antonovsky scales (1993), merely reflects an inverse measure of psychopathology (Geyer, 1997; Gruszczynska, 2006). Correspondingly, studies that have found changes in SOC over short periods of time (Vastamaeki, Moser, & Paul, 2009) and across the lifespan (Breslin, Hepburn, Ibrahim, & Cole, 2006; Feldt, Leskinen, Kinnunen, & Ruoppila, 2003) question SOC's conceptualization as a stable 'dispositional orientation' proposed to stabilize over the lifespan.

To resolve the continuing debate on SOC's conceptual validity, longitudinal research that differentiates between SOC's role as a predictor and outcome of mental health is needed. This is of particular relevance in the context of mental health changes through psychotherapy. To date, only few longitudinal studies have investigated SOC in relation to psychotherapeutic treatment. Further, existing studies have exclusively focused on treatment-related changes in SOC as an outcome. For instance, a 2-year group therapy for women that had experienced sexual childhood abuse significantly increased SOC levels (Lundqvist, Svedin, Hansson, & Broman, 2006). Similar effects were found for an 8-week mindfulness-based stress reduction program in fibromyalgia patients (Weissbecker et al., 2002) and a 57-week rehabilitation program for chronic pain disorder (Lillefjell & Jakobsen, 2007). While these findings provide first indications regarding the temporal (in)stability of SOC and its role as a relevant therapy outcome measure, they do not offer any insights regarding its predictive value. To the best of our knowledge, no study so far has investigated the role of pre-treatment SOC as a predictor of psychotherapy outcome. The current study aims to address this gap by examining SOC's stability during a brief psychosomatic rehabilitation intervention and by analysing its role as a predictor of post-treatment psychopathological symptom levels.

Method

Sample recruitment

The recruitment took place at a psychosomatic rehabilitation clinic in Blieskastel (Germany) from June 2018 until February 2019. Psychosomatic rehabilitation is part of the German system of rehabilitative care [see Lukasczik et al. (2011) for details]. Psychosomatic rehabilitation consists of a 5-to-6-week inpatient treatment aiming to maintain or rebuild patients' employability. Rehabilitation is multidisciplinary and consists of individual and group psychotherapy (based on cognitive behavioural or psychodynamic techniques) and a set of add-on interventions (e.g., psychopharmacological treatment, exercise groups, occupational therapy, etc.), which differ between patients. To monitor treatment quality psychopathological symptoms are usually assessed twice (within two days of arrival and in the last week of patients' stay) using a set of standardized measures. For the current study, patients were additionally asked to complete a questionnaire concerning depressive and aggressive symptoms and two SOC measures (Antonovsky, 1993; Bachem & Maercker, 2016). The findings on the questionnaire assessing depression and aggression and the results of the second SOC measure (Bachem & Maercker, 2016) will be reported elsewhere.

The study was approved by the Ethic Committee of the Saarland University (18-01) and was pre-registered (ID: DRKS00014002). All patients gave written informed consent in accordance with the Declaration of Helsinki (World Medical Association, 2013).

Sample characteristics

Three-hundred-fifteen patients of the psychosomatic rehabilitation clinic participated in the current study. 21 participants were excluded since they did not complete the pre-treatment SOC measure (Figure 1 shows a flow chart of the study sample). Mean age was 53.13 years ($SD = \pm\,7.92$, range: 20-74 years) and 72% of the patients were female. Primary diagnoses according to DSM-5 categories (American Psychiatric Association, 2013) are listed in Supplementary Material A.
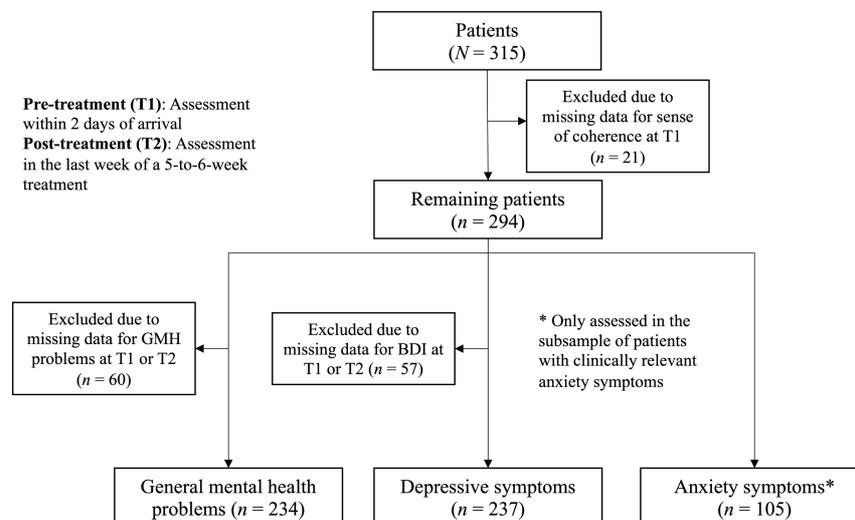
Figure 1. Flow chart of the study sample.

Measures

Sense of coherence

SOC as defined by Antonovsky (1979) was measured using the German 13-item short version of the Antonovsky scales [SOC-13; German version: Singer & Brähler (2007); English original: Antonovsky (1993)]. SOC-13 uses a bipolar 7-point scale with a verbal anchor on each pole. In the current sample, SOC-13 showed good internal consistency reflected in a Cronbach's alpha (α) of .84.

General mental health

General psychopathological symptom burden was assessed using a German self-report questionnaire [original: Hamburger Module zur Erfassung allgemeiner Aspekte psychosozialer Gesundheit für die therapeutische Praxis; HEALTH-49; Rabung et al. (2009)]. The Health-49 comprises 49 items that assess somatic and psychopathological symptoms using six subscales. For the purpose of the current study, the index for general mental health (GMH) problems (original: Psychische und somatoforme Beschwerden) was used. Scores range from 0 to 4. The Health-49 has shown sufficient reliability reflected in $\alpha = .89$ for the GMH problems index (Rabung et al., 2009).

Depressive symptoms

To assess depressive symptoms for the last two weeks, the German version of the Beck Depression Inventory [BDI-II; German version: Hautzinger et al. (2006)] was used. It contains 21 items related to depression with scores ranging from 0 to 63. The BDI-II has shown good internal consistencies in depressive samples ($\alpha = .93$) and in other patient populations ($\alpha = .92$) (Hautzinger et al., 2006).

Anxiety symptoms

Anxiety symptoms for the last week were assessed using the German version of the Beck Anxiety Inventory [BAI; German version: Margraf & Ehlers (2007)]. The BAI contains 21 items related to anxiety and scores range from 0 to 63. Internal consistencies have shown to be high ($\alpha = .90$) (Margraf & Ehlers, 2007). The BAI was administered in the subsample of patients diagnosed with an anxiety disorder.

Data analyses

Analyses were conducted using SPSS version 25 (IBM Corp, 2017). Descriptive statistics were computed to illustrate sample characteristics in terms of frequencies, means (*M*), and standard deviations (*SD*).

Pre- to post-treatment change of psychopathological symptoms and SOC levels were analysed using a *t*-test for paired samples. Bivariate Pearson correlation coefficients were used to assess the relationship between SOC and outcome measures. Fisher's *z*-tests were applied to compare correlations for pre-treatment SOC and pre- and post-treatment symptom measures. In order to control for effects of multiple testing, Bonferroni-Holm corrections were applied (Holm, 1979). To analyse the relevance of pre-treatment SOC as a predictor of treatment outcomes, hierarchical regressions per outcome were

conducted including the first assessment of the outcome (pre-treatment levels for GMH problems, depression and anxiety symptoms) in the first step and pre-treatment SOC in the second step. We used a regression approach since this was shown to be superior to correlation analyses using change scores (Overall & Woodward, 1975). The change in R^2 (ΔR^2) represents the unique amount of variance accounted for by SOC. ΔF was used to assess the significance of ΔR^2. Due to missing data, degrees of freedom varied between analyses.

Results

Pre- to post-treatment changes in symptom levels and SOC

Paired *t*-tests for all outcome measures show a significant decrease in symptom severity for GMH problems [$t(233) = -13.33$, $p < .001$, $d = 0.87$], depression [$t(236) = 15.71$, $p < .001$, $d = 1.02$], and anxiety [$t(104) = 5.16$, $p < .001$, $d = 0.50$] from pre- to post-treatment. By contrast, SOC increased significantly during this period of time [$t(167) = 4.51$, $p < .001$, $d = 0.35$] (see Table 1 for descriptive statistics).

Bivariate correlations between SOC and measures of psychopathological symptoms

Table 1 presents the Pearson correlation coefficients between SOC and all outcomes (i.e., GMH problems, depressive and anxiety symptoms). SOC showed significant associations with all symptom measures at the pre- and post-treatment assessments (all *p*s < .001). Numerically larger correlations were observed between SOC and symptom scores measures at the same time point (pre- and post-treatment) (e.g., pre-treatment SOC and pre-treatment BDI at vs. pre-treatment SOC and post-treatment BDI). However, after applying Bonferroni-Holm corrections (1979) these differences were only significant for the correlation between pre-treatment SOC levels and depressive symptoms pre- vs. post-treatment ($p = .030$) (see Supplementary Material B for all pairwise comparisons).

Table 1. Relationship between mental health outcomes and sense of coherence

	M (*SD*)	2	3	4	5	6	7	8
BDI - T1 (1)	22.89 (10.98)	.54**	.77**	.55**	.67**	.46**	-.58**	-.45**
BDI - T2 (2)	12.17 (11.01)		.49**	.82**	.51**	.77**	-.40**	-.54**
GMH problems - T1 (3)	1.53 (0.79)			.67**	.77**	.54**	-.56**	-.41**
GMH problems - T2 (4)	0.99 (0.74)				.63**	.85**	-.46**	-.52**
BAI - T1 (5)	23.47 (12.76)					.66**	-.50**	-.52**
BAI - T2 (6)	18.13 (13.01)						-.44**	-.60**
SOC - T1 (7)	49.43 (12.07)							.58**
SOC - T2 (8)	53.26 (11.92)							

Note. BDI = Beck Depression Inventory II. GMH problems = Health-49 subscale for general mental health problems. BAI = Beck Anxiety Inventory. SOC = Sense of coherence scale - short version. T1 = assessment within two days of arrival, i.e., pre-treatment. T2 = assessment within the last week of a 5/6-week treatment, i.e., post-treatment.
** *p* < .001

Prediction of symptom change based on pre-treatment SOC

Multiple hierarchical regressions were used to predict symptom changes based on pre-treatment SOC (see Table 2). Pre-treatment symptom and SOC levels significantly predicted post-treatment GMH problems [R^2 = .47, F(2, 231) = 100.56, p < .001]. Pre-treatment SOC explained a significant but small unique amount of variance (ΔR^2 = .01) in post-treatment GMH problems [β = -.13, t(231) = -2.20, p = .029], whereby higher pre-treatment SOC levels were related to fewer post-treatment symptoms. However, both predictors shared 19% of the explained variance in post-treatment symptom levels.

Analyses concerning depression symptoms, revealed similar results. Taken together pre-treatment depression levels and pre-treatment SOC accounted for 31% of the variance in post-treatment depression [F(2, 234) = 52.48, p < .001]. Again, pre-treatment SOC explained a significant (ΔR^2 = .01) - although small - amount of variance in post-treatment depression [β = -.14, t(234) = -2.21, p = .035]. Higher levels of pre-treatment SOC were associated with fewer remaining depressive symptoms. Both predictors shared 15% of the variance in post-treatment symptom levels.

Albeit in a smaller sample, a similar pattern of results was found for anxiety symptoms (*n* = 104). Taken together, pre-treatment anxiety symptoms and pre-treatment SOC accounted for 46% of variance in post-treatment symptoms [F(2, 102) = 43.55, p < .001]. Pre-treatment SOC included in the second step explained a small but significant (ΔR^2 = .02) unique amount of variance [β = -.17, t(102) = -2.06, p = .042]. Again, higher levels of pre-treatment SOC were related to fewer post-treatment anxiety

symptoms. However, a large amount of variance in post-treatment anxiety levels (18%) was shared by both predictors.

Table 2. Prediction of change in symptoms based on pre-treatment sense of coherence

	B	SE B	β	t	p	ΔR^2	ΔF
General mental health problems (T2, post-treatment)							
GMH problems - T1	0.57	0.05	.61	10.54	< .001	.26	111.03
SOC - T1	-0.01	0.00	-.13	-2.20	.029	.01	4.84
Depressive symptoms (T2, post-treatment)							
BDI - T1	0.47	0.07	.47	7.12	< .001	.15	50.68
SOC - T1	-0.12	0.06	-.14	-2.12	.035	.01	4.48
Anxiety symptoms (T2, post-treatment)							
BAI - T1	0.59	0.08	.58	7.06	< .001	.26	49.90
SOC - T1	-0.18	0.09	-.17	-2.06	.042	.02	4.23

Note. The columns reporting ΔR^2 and ΔF refer to hierarchical regression analyses in which each variable was included in the last step. *p*-values of the beta-weights and ΔF are equal and hence not reported twice.
BAI = Beck Anxiety Inventory. BDI = Beck Depression Inventory II. GMH = Health-49 subscale for general mental health problems. SOC = Sense of coherence scale - short version. T1 = assessment within two days of arrival, i.e., pre-treatment. T2 = assessment within the last week of a 5/6-week treatment, i.e., post-treatment.

Discussion

The current findings demonstrate that SOC as measured by the 13-item Antonovsky scale (1993) increased during a brief intervention in a psychosomatic rehabilitation clinic. Changes in SOC were small to medium but significant. Correlation analyses revealed that pre-treatment and post-treatment SOC levels were significantly associated with all measures of symptom burden. Critically, pre-treatment SOC predicted symptom change for all outcomes, i.e., GMH problems, depression, and anxiety symptoms. SOC's contribution remained significant even after controlling for pre-treatment symptom levels, which accounted for considerably larger amounts of variance ($\geq 15\%$) than pre-treatment SOC levels alone ($\leq 2\%$).

In line with previous findings (Lillefjell & Jakobsen, 2007; Lundqvist et al., 2006; Weissbecker et al., 2002), the current study shows that SOC levels were affected by psychotherapy and increased as symptom levels decreased. However, in contrast to prior studies that investigated interventions of at least two months in younger populations ($M_{age} \leq 48$ years), our findings demonstrate that changes in SOC might also occur following brief interventions and in older populations. This, in turn, challenges Antonovsky's (1979, 1987) conceptualization of SOC as a dispositional orientation stabilizing over the lifespan beginning at the age of 30 (Mittelmark et al., 2017). In line with this, additional exploratory analyses did not provide evidence for a moderating effect of age on pre- to post-treatment SOC changes ($p = .612$).

Corresponding to previous studies (del-Pino-Casado et al., 2019; Streb, Häller, & Michael, 2014), we found a robust relationship between SOC levels and psychopathological symptoms, which was also reflected in a large overlap of explained variance in post-treatment symptom levels for all outcomes.

However, the current findings also demonstrate that pre-treatment SOC levels uniquely predict changes in symptom severity. This pattern of results was found to be remarkably consistent across all outcome measures. As such, our results provide first evidence that SOC is a unique predictor of changes in mental health and not merely an inverse measure of psychopathology (Geyer, 1997; Gruszczynska, 2006). Thus, while SOC seems to constitute a partly overlapping construct, it is not redundant.

It is important to address the limitations of the current study. Due to non-random post-treatment missing data for SOC levels, we were not able to apply random intercept cross-lagged panel models which are more suited to establish causality in longitudinal panel data (Hamaker, Kuiper, & Grasman, 2015). Future studies should use these models in larger samples. Furthermore, our study used a brief and multidisciplinary intervention that also included psychopharmacological treatment. This may have resulted in high proportions of unsystematic variance. Moreover, the predictive validity of SOC as a global orientating in life might be more pronounced studying interventions using more homogeneous samples [e.g., traumatized individuals, as SOC has been shown to be strongly related to posttraumatic stress symptoms (Schäfer et al., 2019)] and manualized interventions. Due to high rates of comorbidity in the current sample, we were not able to assess if the predictive value of pre-treatment SOC levels varied between different patient groups (e.g., depressive vs. anxiety disorders). Future studies should close this gap.

Overall, the current study demonstrates that SOC levels increased during a 5/6-week rehabilitation treatment. Moreover, for the first time, we showed that pre-treatment SOC levels were predictive of post-treatment psychopathological symptoms, i.e., general mental health problems, depression and anxiety symptoms. Future research should investigate the influence of SOC as a predictor of treatment outcome over longer periods of time, in various settings and patients, as well as using advanced assessment methods such as frequent ambulatory assessments allowing for cross-lagged panel analyses.

Abbreviations

BAI: Beck Anxiety Inventory; BDI-II: Beck Depression Inventory II; DSM-5: Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition; GMH: general mental health; HEALTH-49: Hamburger Module zur Erfassung allgemeiner Aspekte psychosozialer Gesundheit für die therapeutische Praxis; SOC: sense of coherence

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Supplementary Material

Supplementary Material A

Table A-1. Patient characteristics according to DSM-5 categories (primary diagnoses)

Primary diagnosis	females		age	
	n	%	*M*	*SD*
Depressive disorders	82	73.2	53.93	6.94
Bipolar and related disorders	2	100.0	49.50	0.71
Anxiety disorders	26	61.5	50.91	8.50
Obsessive-compulsive and related disorders	1	100.0	20.00	-
Trauma- and stressor-related disorders	115	67.0	53.10	8.66
Adjustment disorder	109	63.4	53.44	8.64
Posttraumatic stress disorder	6	100.0	47.75	5.74
Somatic symptom and related disorders	49	87.8	54.40	4.88
Substance-related and addictive disorders	1	100.0	59.00	-
Neurodevelopmental disorders (i.e., ADHD)	1	0	58.00	-
Personality disorders	2	0	48.50	16.26

Note. ADHD = attention deficit hyperactivity disorder*; M* = mean; *SD* = standard deviation.

Supplementary Material B

Table B-1. Comparisons of correlation coefficients between SOC and symptom measures for pre- and post-treatment assessments

Correlations	r	Z	p
SOC – T1 and BDI – T1 vs.	-.58		
SOC – T1 and BDI – T2	-.40	-2.59	.030[BH]
SOC – T1 and GMH problems – T1 vs.	-.56		
SOC – T1 and GMH problems – T2	-.46	-1.41	.079
SOC – T1 and BAI – T1 vs.	-.50		
SOC – T1 and BAI – T2	-.44	-0.58	.281
SOC – T2 and BDI – T1 vs.	-.45		
SOC – T2 and BDI – T2	-.54	-1.08	.141
SOC – T2 and GMH problems – T1 vs.	-.41		
SOC – T2 and GMH problems – T2	-.52	-1.24	.108
SOC – T2 and BAI – T1 vs.	-.52		
SOC – T2 and BAI – T2	-.60	-0.70	.242

Note. Results of *z*-tests comparing the correlation coefficients between SOC and outcome measures at pre- and post-treatment assessment. *p*-values are corrected using Bonferroni-Holms corrections for multiple comparisons in case of significant results (indicated by [BH]).

BDI = Beck Depression Inventory II. GMH problems = subscale for general mental health problems of the Health-49. BAI = Beck Anxiety Inventory. SOC = Sense of coherence scale – short version. T1 = assessment within two days of arrival. T2 = assessment within the last week of a 5/6-week treatment.

Schäfer, S. K., Sopp, R., Wirth, B., Schanz, C. G., Staginnus, M., Becker, N., & Michael, T. (2019). *The relationships between resilience-related concepts and PTSD symptom severity: A meta-analytical investigation*. In preparation.

Abstract

Background. The umbrella term 'resilience' encompasses more than the absence of posttraumatic stress disorder (PTSD). However, its precise conceptualization is currently debated. Apart from single studies on bivariate associations, little is known about intercorrelations between resilience-related concepts. A comprehensive meta-analysis on these relationships and their unique association with posttraumatic outcomes is still missing. To close this gap, the current meta-analytical investigation firstly examines the relationship between resilience-related constructs [sense of coherence (SOC), trait-resilience, hardiness, locus of control (LOC), self-efficacy, sense of mastery (SOM), dispositional optimism, and openness] and outcomes of traumatic exposure (PTSD symptoms and posttraumatic growth).

Method. The literature search was conducted in five databases. Random effects meta-analyses based on zero-order correlations (r) were performed.

Results. The meta-analyses included 142,468 participants, investigated in 339 studies. SOC was identified as the strongest correlate of PTSD symptoms, $M(r) = -.40$, but was not significantly related to PTG, $M(r) = .06$. Moreover, further analyses showed that trait-resilience and hardiness as well as LOC and SOM could be combined without increases in heterogeneity. In meta-analytical regression models both trait-resilience/hardiness and LOC/SOM did not show incremental validity beyond SOC.

Conclusion. Overall, SOC was found to be the most important correlate of PTSD symptoms. Future prospective studies need to further investigate this relationship.

Keywords: resilience, sense of coherence, meta-analysis, posttraumatic stress disorder, posttraumatic growth, review

Introduction

Across the global, approximately 70% of individuals are exposed to at least one traumatic event during their lifetime (Benjet et al., 2016; Liu et al., 2017). This high prevalence also applies to regions that are usually associated with low rates of collective violence such as Europe (Krug, Mercy, Dahlberg, & Zwi, 2002). According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition [DSM-5; American Psychiatric Association (2013)], traumatic events are defined as exposure to actual or threatened death, severe trauma or sexual violence in at least one way: (1) direct exposure to the traumatic event; (2) witnessing the traumatic event as they occur to others; (3) learning that intimate family members or close friends have experienced a traumatic event; (4) repeated or extreme exposure to aversive details of events, such as in first responders. Following exposure to a traumatic event, approximately 5 to 30% of trauma survivors develop posttraumatic stress disorder (PTSD) as a consequence (Shigemoto, Low, Borowa, & Robitschek, 2017). This varying prevalence mostly dependents on trauma-related factors such as type of trauma (Kessler et al., 2017). Accordingly, incidences differ widely across trauma types [e.g., 2% after accidental injuries (Schnyder, Moergeli, Klaghofer, & Buddeberg, 2001) vs. 23% after hurricane Katrina (Galea, Tracy, Norris, & Coffey, 2008)]. Furthermore, research demonstrates an impact of the duration of exposure on clinical status (Kaysen, Rosen, Bowman, & Resick, 2010), which is not yet fully understood. A simple dose-response model may not be appropriate, although this has been shown - albeit with a small effect size - for traumatic events such as mass shootings (Wilson, 2014).

Furthermore, a recent review underlined the substantial medical and economic burden caused by PTSD (Watson, 2019). The high individual strain is further aggravated by frequent comorbidities, such as major depression (Rytwinski, Scur, Feeny, & Youngstrom, 2013) and substance abuse disorders (Pietrzak, Goldstein, Southwick, & Grant, 2011). On an economical level, PTSD is associated with substantial work impairment (Wald & Taylor, 2009) and high public health care costs (Alonso et al., 2004; Olesen et al., 2012).

As these findings underline, trauma can cause substantial psychological harm. However, most individuals faced with a traumatic event do not develop PTSD (or other mental health disorders) (Bonanno & Mancini, 2012; Kilpatrick et al., 2013). Moreover, some even experience posttraumatic growth (PTG), which reflects positive psychological change following exposure to a traumatic event (Tedeschi & Calhoun, 1996). Individuals that maintain or quickly rebuild their mental health following traumatic events are usually characterized as being *resilient*. Resilience can broadly be defined as the ability to adapt successfully in the face of adversity, trauma, tragedy or any other significant threat (Horn, Charney, & Feder, 2016). In this context, resilience has increasingly been conceptualized as more than the mere absence of psychopathology (Almedom & Glandon, 2007; Galatzer-Levy, Huang, & Bonanno, 2018; Southwick, Bonanno, Masten, Panter-Brick, & Yehuda, 2014). However, its precise conceptualization and operationalization are still debated (Horn et al., 2016; Southwick et al., 2014). Three main approaches to defining resilience need to be distinguished (Hu, Zhang, & Wang, 2015): (1)

Resilience can describe a stable personality trait that inoculates individuals against the potential negative impact of adversity or traumatic event. Most research following this line of thinking is conducted using trait-resilience questionnaires [such as the Connor-Davidson Resilience scale (CD-RISC); Connor & Davidson (2003)]. (2) However, resilience has also been conceptualized as an outcome as reflected in low rates or even the absence of psychopathological symptoms after stressful experiences or traumatic events. Studies following this approach predominantly use measures of psychopathological symptom burden as an inverse operationalization of resilience (Bonanno, Galea, Bucciarelli, & Vlahov, 2007). (3) Finally, a third conceptualization that has been increasingly employed in recent research (Southwick et al., 2014), understands resilience as an active process of recovering after aversive life events. This approach does not inherently preclude the simultaneous presence of psychopathological symptoms and resilience. Lately, studies on trajectories of resilience have aimed to apply this process-based approach using longitudinal symptom monitoring following adversity and identified resilience as the modal response (average of 66% across populations) to potentially traumatic events [for a review see Galatzer-Levy et al. (2018)]. Unfortunately, to date, only a few studies have combined trait-based and process-oriented approaches by assessing both trait variables and psychopathological symptoms over longer periods of time.

Linking in with the variable conceptualization of resilience, multiple constructs have been defined as directly relating to resilience. Most closely aligned with the first conceptualization of resilience as a trait is the construct of trait-resilience, defined as the "personal qualities that enable one to thrive in the face of adversity" [Connor & Davidson (2003), p. 76], which overlaps to varying extents with many similar and interrelated concepts. These concepts are hardiness (Kobasa, 1979), sense of coherence (Antonovsky, 1979), locus of control (Rotter, 1966), self-efficacy (Bandura, 1977), sense of mastery (Pearlin & Schooler, 1978), dispositional optimism (Scheier & Carver, 1987), and openness to new experiences (Costa & McCrae, 1992; Williams, Rau, Cribbet, & Gunn, 2009).

Hardiness is a "a general sense that the environment is satisfying" (Maddi & Kobasa, 1984, p. 50) that leads an individual to approach situations with curiosity, enthusiasm, and commitment. Hardiness shows the strongest conceptual overlap with trait-resilience. This is also reflected in the inclusion of subscales assessing hardiness in some measures of trait-resilience (Windle, Bennett, & Noyes, 2011). Moreover, the most prominently used scale for the assessment of hardiness is the *Dispositional Resilience Scale* (Bartone, 1991), implying a close relationship with trait-resilience. Hardy individuals are assumed "to remain healthy under stress" (Funk, 1992, p. 335). Correspondingly, studies have found a strong positive relationship between hardiness and mental health (Eschleman, Bowling, & Alarcon, 2010) and a negative association between hardiness and PTSD symptoms (Escolas, Pitts, Safer, & Bartone, 2013).

Another concept frequently studied in the context of resilience is sense of coherence (SOC). SOC is defined as "a global orientation that expresses the extent to which one has a pervasive and enduring, though dynamic, feeling of confidence that one's internal and external environments are predictable,

and that there is a high probability that things will work out as well as can reasonably be expected" [Antonovsky (1979), p. 10]. It is the key component of the salutogenesis theory coined by Aaron Antonovsky (1979, 1987) and is believed to motivate and mediate successful coping processes through its components *manageability*, *comprehensibility*, and *meaningfulness*. In line with the salutogenesis framework, SOC - usually assessed using either the short or the long version of the scales developed by Antonovsky (1993) - has been shown to have a strong relationship with mental health (Eriksson & Lindström, 2006) and a particularly robust relationship with PTSD symptoms (Schäfer, Becker, King, Horsch, & Michael, 2019). Compared to other resilience-related concepts, such as trait-resilience and locus of control, studies identified SOC as the stronger correlate of PTSD symptoms [e.g., Schäfer et al. (2018); Streb, Häller and Michael (2014)].

Locus of control (LOC) (Rotter, 1966) is also discussed as a resilience-related factor and assesses the degree to which individuals have the perception that events are controllable through their own actions (internal LOC) or predominantly dependent on factors beyond one's personal influence (external LOC). LOC can be assessed as a unipolar or bipolar construct, whereby the bipolar conceptualization seems to be more appropriate and predictive in terms of mental health (Gore, Griffin, & McNierney, 2016). However, particularly earlier research has been limited by the use of unipolar instruments. With respect to health, a stronger internal LOC and a weaker external LOC were found to be related to beneficial health outcomes (Strickland, 1978) and to be predictive of the development and course of PTSD (Solomon, Mikulincer, & Avitzur, 1988; Zhang, Liu, Jiang, Wu, & Tian, 2014).

Not initially originating from research into health or resilience, perceived self-efficacy (Bandura, 1977) reflects an individual's sense of control over their environment as well as his/her belief in their ability to master demands by means of adaptive action. In the context of trauma, self-efficacy was found to be an important determinant of posttraumatic recovery defined as posttraumatic psychosocial function and PTSD symptom levels (Benight & Bandura, 2004). Moreover, a meta-analysis identified self-efficacy as an important correlate of posttraumatic stress symptoms following collective trauma (Luszczynska, Benight, & Cieslak, 2009).

Sense of mastery describes "the extent to which one regards one's life-changes as being under one's own control in contrast to being fatalistically ruled" (Pearlin & Schooler, 1978, p. 5). Thereby, sense of mastery translates the general concept of LOC to the field of personal life changes (Gallagher, Long, Richardson, & D'Souza, 2019). As in the case of LOC, sense of mastery was shown to be a robust correlate of physical (Surtees, Wainwright, Luben, Khaw, & Day, 2006) and mental health (Dalgard, Mykletun, Rognerud, Johansen, & Zahl, 2007). In the context of PTSD, a stronger sense of mastery was found to be related to less severe PTSD symptoms (Potter et al., 2013).

In contrast to the aforementioned resilience-related concepts, dispositional optimism is clearly related to the expectancy of a positive outcome. Dispositional optimism is defined as one's general belief "that the good rather than bad things will happen" [Scheier and Carver (1985), p. 219]. This generalized expectancy of positive outcomes demonstrated a positive association with successful coping

strategies (Nes & Segerstrom, 2006) and mental health (Andersson, 1996). With respect to PTSD symptoms, studies demonstrated a negative relationship between dispositional optimism and symptom levels (Gil & Weinberg, 2015).

Unlike the previous concepts, which are more or less closely related to research on (mental) health, openness to experience originates from the 'Big Five' model of personality traits (Costa & McCrae, 1992). Nonetheless, studies have shown that openness to experience shows a positive association with physical health (Jonassaint et al., 2007) that might be mediated by its association with physiological stress responses (Williams et al., 2009). A recent study also suggested that openness to experience might be negatively associated with PTSD symptoms (DeViva et al., 2016).

In addition to resilience-related concepts and corresponding to resilience's conceptualization as an outcome, PTG (Tedeschi & Calhoun, 1996) is also frequently studied in the context of resilience after trauma. For the purpose of the current meta-analytical investigation, PTG was also conceptualized as posttraumatic outcome. Notably, PTG itself has also been interpreted as coping strategy [for a detailed discussion on the concept of PTG, see: Maercker and Zoellner (2004); Schubert et al. (2016)].

All resilience-related concepts share some similarities (see Figure 1): t

hey all represent pre-trauma traits that are believed to influence psychological reactions to traumatic events as well as subsequent coping processes. While trait-resilience, hardiness, and SOC are conceptualized as traits that enable individuals to deal with stressors in a beneficial way, LOC, self-efficacy, sense of mastery as well as dispositional optimism are mainly focused on perceived (internal or external) control over outcomes and/or outcome quality. By contrast, openness to experience is conceptualized as a trait similar to SOC, trait-resilience, and hardiness; however, openness to experience has a less direct association with coping processes. Some theoretical considerations also challenge the distinctness of specific resilience-related concepts: the strongest overlap may exist between trait-resilience and hardiness, which both originate from research into personality traits that enable an individual to cope successfully with life stressors. Moreover, for apparent reasons also the internality and externality dimension of LOC overlap and were not even differentiated in early research on LOC (e.g., Solomon et al., 1988). Furthermore, sense of mastery may be seen as a translation of the more general LOC concept to biographical challenges.

Resilience-related concepts

Trait-resilience
(Werner, 1972)

Hardiness (Kobasa, 1979)

Control-related concepts

Locus of control (Rotter, 1966)

Sense of mastery
(Pearlin & Schooler, 1978)

Other resilience-related concepts

Sense of coherence
(Antonovsky, 1979)

Self-efficacy (Bandura, 1977)

Dispositional optimism
(Scheier & Carver, 1987)

Openness to experience
(Costa & McCrae, 1992)

correlational research

Exposure to trauma or adversity

Coping process

process-oriented approaches

Outcomes as indicators of coping results

Measures of psychopathology and/or mental health

- Posttraumatic stress symptoms
- Posttraumatic growth
(Tedeschi & Calhoun, 1996)

correlational research

Figure 1. Schematic illustration of all resilience-related concepts and different approaches in research into resilience. Dark blue arrows mark concepts that are supposed to show the greatest conceptual overlaps.

Overall, there is a wide range of research investigating correlates of beneficial outcomes after stress and trauma, that is the absence or lower levels of psychopathological symptoms and/or posttraumatic growth. Unfortunately, research on resilience-related concepts is predominantly motivated by narrow research interests and little effort has been put into a precise differentiation of these concepts and a superordinate framework. Accordingly, there are only very few studies (e.g., Grevenstein, Aguilar-Raab, Schweitzer, & Bluemke, 2016; Kooranian, Khosravi, & Esmaeeli, 2008; Streb et al., 2014) that compare the unique associations of resilience-related concepts with beneficial outcomes after trauma. Moreover, due to restricted sample sizes, even these studies were unable to focus on more than two or three concepts.

Taken together, the lack of conceptual clarity may result in the co-existence of concepts that do, or do not all exhibit incremental validity beyond others. To date, it is not clear which concepts possess such incremental validity, which in turn makes it more difficult to transfer findings from research into resilience to clinical practice. Such a transfer would need a focus on specific concepts found to be most relevant. Moreover, despite meta-analyses and reviews investigating specific associations of resilience-related concepts with PTSD symptoms (e.g., Benight & Bandura, 2004; Schäfer et al., 2019) and posttraumatic growth (Schubert, Schmidt, & Rosner, 2016), a joint meta-analytical investigation of these resilience-related concepts and their relationship with PTSD symptoms and PTG is still missing. Consequently, the current meta-analytical investigation has three goals: first, to provide a

comprehensive overview of the bivariate associations between resilience-related concepts and PTSD symptoms and PTG as respective primary and secondary outcomes. Second, the set of meta-analyses aims to test the empirical overlap between different resilience-related concepts and to answer the question whether some of them might be reflective of a common underlying factor. Third, for the first time the current study will provide an estimation of the unique associations of these concepts and PTSD symptom severity using meta-analytical regression models.

Method

This meta-analytical investigation was prepared in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, Altman, & Group, 2009).

Search strategy

Relevant search terms were defined in the research team to cover the most commonly used terms in the literature on resilience-related concepts, PTSD symptom severity, and posttraumatic growth. Using these terms, a literature search based on title, abstract, and keywords was conducted in five databases: EBSCO (including PsycARTICLES and PsycINFO), PTSDpubs, PubMed, and Scopus. No date of publication criterion was used (all databases dated back to at least 1945). Search terms, search engines, and hits per search engine are displayed as Figure 2. The literature search started in October 2018 and corresponding alerts were followed up until April 2019. Moreover, the project was advertised on Twitter, ResearchGate, and at the 35th annual meeting of the International Society for Traumatic Stress Studies (Boston, 2019) to increase the likelihood to include unpublished data. For the purpose of the current draft, study inclusion ended on August 31th 2019.
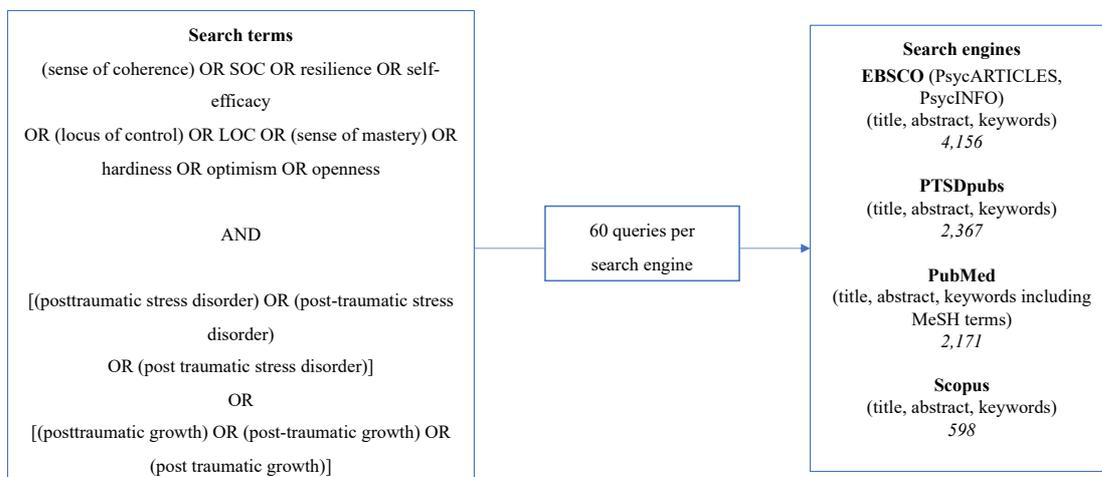
Figure 2. Search terms and search engines, as well as hits per database.

Study selection

Inclusion criteria

Studies were required to meet the following criteria to be included: (1) The study reported a zero-order correlation between a resilience-related concept (i.e., SOC, trait-resilience, self-efficacy, LOC, sense of mastery, hardiness, dispositional optimism or openness to experience) and PTSD symptom severity/PTG. Studies were also included if the authors sent us such a correlation coefficient. (2) The resilience-related concept and PTSD symptoms or posttraumatic growth were assessed using well-established questionnaires or clinical interviews including a severity rating in case of PTSD [e.g., Clinician-Administered PTSD scale for DSM-5; Weathers et al. (2013)]. (3) Participants were 18 years or older at the time of assessment. However, studies reporting findings on adult samples that experienced potentially stressful or traumatic event as children were included. (4) The study or at least the abstract and all relevant information were made available in English.

Studies reporting findings on samples that did not explicitly experienced a traumatic event were also included. Excluding these studies was not deemed appropriate due to the high prevalence of traumatic events in the general population (Benjet et al., 2016; Kessler et al., 2017). Moreover, only a minority of studies assessed DSM-5 (American Psychiatric Association, 2013) or DSM-IV-TR (American Psychiatric Association, 2000) criteria for traumatic events in each participant. Criterion A of the PTSD diagnostic criteria requires that the individual was exposed to an event that they experienced as involving actual or threatened death, serious injury, and/or sexual violence. Based on these considerations, we decided to include three types of samples: samples for which exposure to a criterion A traumatic event was established on an individual basis (trauma only), those that are likely to have experienced a traumatic event (high-risk population), and unselected samples (general population) for which the likelihood of a traumatic event was as high as in the general population. Differences between these types of samples were analyzed using subgroup moderator analyses for all resilience-related concepts.

Process of study selection

An overview of the study selection process is depicted in the PRISMA flowchart in Figure 3. Four junior researchers (i.e., master students) screened titles, abstracts, and keywords for potential eligibility. On a trial run of 200 records, a high average inter-rater agreement ($\geq 95\%$) was achieved with the first author (SKS) for inclusion/exclusion decisions. After abstract screening the full texts of 1,534 records were independently assessed for inclusion by pairs of junior and senior researchers (BEW, CGS, MRS, MS, and SKS), resulting in 1,200 potentially relevant studies. Of these, 339 studies provided sufficient information to be included. In 333 cases where the studies met all inclusion criteria, but did not report a zero-order correlation, the corresponding authors were contacted via e-mail to send us the required information. In these e-mails we also asked the authors to share additional data, which would be relevant to the meta-analytical investigation. In total, we were able to include 339 studies comprising 364 samples.
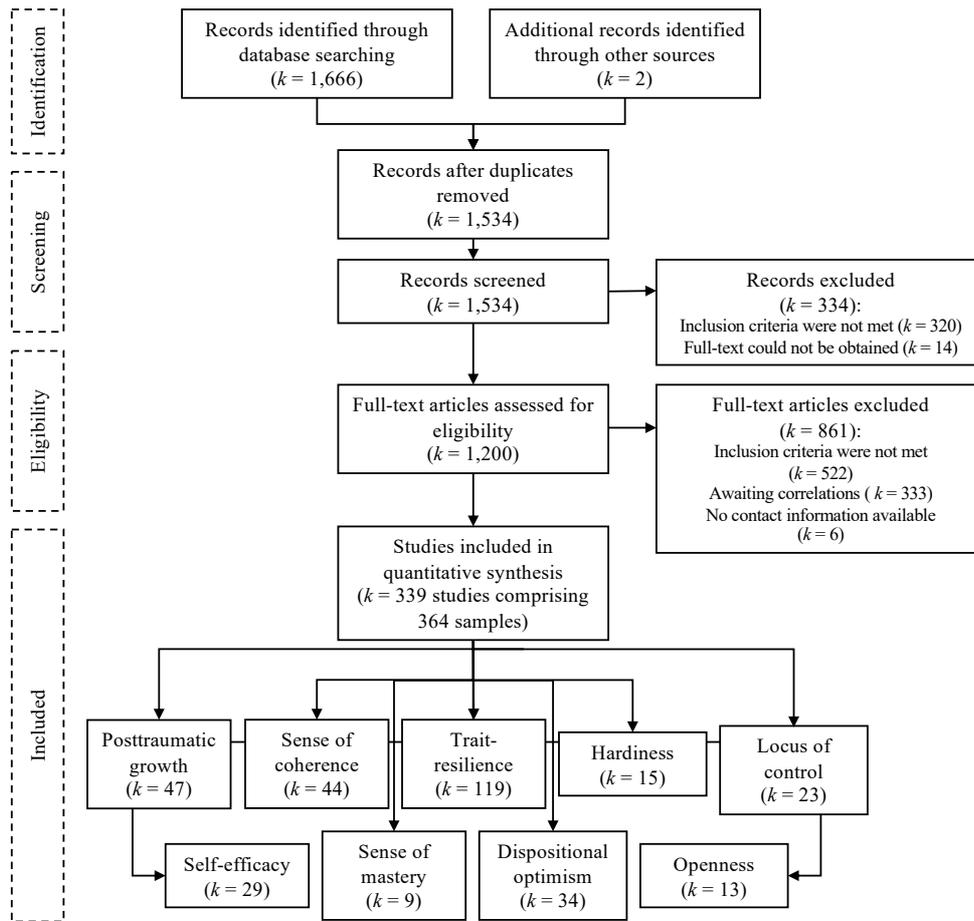
Figure 3. Flow chart of the study selection process following PRISMA guidelines.

Data extraction

Data of each study was extracted using a standardized Excel form by pairs of independent coders consisting of a junior and a senior researcher. For each sample, zero-order correlation coefficients between all relevant concepts (i.e., PTSD symptoms, PTG, SOC, trait-resilience, self-efficacy, LOC, sense of mastery, hardiness, dispositional optimism or openness to experience) were coded with the respective *n*. In case more than one correlation coefficient of the same association was reported (e.g., zero-order correlations were calculated for two measurements of PTSD or at two time points), we calculated a mean weighted correlation using Fishers *Z*-transformations. The interrater agreement across coding teams was high: 90% for correlation coefficients (*r*) and 95% for *ns*. Other coded variables were related to general study characteristics (e.g., sample age, gender imbalance) or planned moderator analyses (e.g., type of traumatic event).

Meta-analyses

Effect size calculation

The effect size per sample was calculated using *R* (R Development Core Team, 2017) and the *metafor* package (Viechtbauer, 2010). This resulted in a correlation coefficient per study and its corresponding

confidence interval (CI). All analyses used random-effects models that allow for true between-study variations and for inferences relevant not only to included samples but to a wider population (Field & Gillett, 2010). Correlation coefficients [M(r)] were used as an estimate of the population effect and their 95% confidence interval (CI) as an indicator of their significance. Residual heterogenity of study effects was assessed by means of τ^2, Cochran's Q statistic, and I^2, which expresses heterogeneity as a percentage with 25% considered as low, 50% as moderate, and 75% as high heterogeneity (Higgins, Thompson, Deeks, & Altman, 2003).

Outlier and influence analyses

Outlier and influence analyses relied on studentized deleted residuals (SDRs), Cook's distances (CD), and covariance ratios (COVRATIO). SDRs below and above ± 1.96 (Viechtbauer, 2010), CD values above .45 (Cook & Weisberg, 1982), and COVRATIOs below 1.00 (Viechtbauer, 2010) were considered as outliers.

Overlap between concepts

Based on theoretical considerations challenging the distinctness of some resilience-related concepts, changes in heterogeneity were used to test the potential integration of specific concepts. To this end, a meta-analysis on trait-resilience measures only was compared with a meta-analysis including measures of trait-resilience and hardiness. Moreover, we compared meta-analyses on internal and external LOC separately with a joint meta-analysis (inverting the relationship between external LOC and PTSD symptoms). Finally, we analyzed the change in heterogeneity when including sense of mastery measures into the meta-analysis on the relationship between (internal and inverted external) LOC and PTSD symptoms. Differences in heterogeneity were assessed based on I^2 values and their 95% CIs, which - different from Cochran's Q statistic - not directly dependent on the number of included studies per meta-analysis. In case of overlapping CIs between meta-analyses combining or differentiating the concepts, we concluded on substantially overlapping concepts and combined the concepts for subsequent analyses.

Moderator analyses

The influence of moderator variables was assessed using subgroup meta-analyses for categorial variables (e.g., trauma type, duration of exposure) and meta-regression for continuous moderators (e.g., sample age, gender imbalances). In case of subgroup meta-analyses non-overlapping 95% CIs of moderator levels indicate a significant moderating influence. For meta-regression analyses, a significant *QM* statistic was used to indicate a substantial moderator effect.

Meta-analytical regression models

Based on the estimated pooled correlation matrix, we specified two meta-analytical regression models (i.e., path models) to analyze the specific and shared amounts of variance in the primary outcome variable, PTSD symptoms[20] (Kriegbaum, Becker, & Spinath, 2018). We calculated baseline models in which PTSD symptoms were solely explained by one predictor[21] [i.e., SOC, trait-resilience/hardiness, internal and (inverted) external LOC/SOM]. These models were compared with alternative models including all predictor variables, hence yielding the amount of variance accounted for by all predictor variables. The specific proportion of variance ($\Delta R^2_{predictor}$) explained by each variable was calculated by subtracting the sum of the proportions of variance explained by all other predictors from the amount of variance which was explained by the model including all predictor variables. The significance of each $\Delta R^2_{predictor}$ was assessed using partial F-tests (Tabachnick, Fidell, & Ullman, 2007). Furthermore, the proportion of variance that was shared by the predictors (R^2_{shared}) was assessed by subtracting all specific amounts of variance accounted for by each predictor from the variance explained by the model including all predictors. These analyses were conducted using the *lavaan* package (Rosseel, 2012) in *R* (R Development Core Team, 2017). In accordance with Landis (2013), the harmonic mean of sample sizes of the all included studies was used as sample size of the meta-analytical path model. This approach limits the influence of larger samples, resulting in more conservative results.

Risk of bias assessments

Results of the meta-analyses may overestimate the true population effect in presence of publication bias (Ferguson & Brannick, 2012). We used different strategies to reduce its potential impact: on the one hand, we tried to include as much unpublished data as possible by contacting all corresponding authors of studies that assessed relevant resilience-related concepts but did not report on a zero-order correlation (see 2.2.2). On the other hand, the impact of a publication bias was assessed statistically using funnel plots and rank correlations (Kendall's τ) to test their symmetry. A significant rank correlation test can be interpreted as a non-normal distribution of effect sizes around the mean effect, reflective of publication bias (Begg & Mazumdar, 1994). Additionally, when the rank correlation test indicated publication bias, the trim-and-fill method would have been applied to statistically correct for the potential influence of publication bias (Duval & Tweedie, 2000). 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.

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[20] Since PTG was not conceptualized as the primary outcome of the current meta-analytical investigation, we concentrated our moderator analyses and meta-analytical regression models on PTSD symptoms.

[21] Importantly, words like 'predict', 'predictor', 'importance/relevance for PTSD symptoms' are used in the sense of statistical prediction (i.e., regression analysis) and do not imply temporal causality.

Results

Sample description

The total sample consisted of $N = 142,468$ participants derived from 339 studies (including 364 samples). The mean weighted age was $M = 37.63$ ($SD = 11.21$) and 36% ($SD = 29.81$) of the participants were female. Excluding all outliers, the total sample consisted of $N = 138,581$ participants out of 328 studies (including 351 samples). The mean weighted age excluding the outlying samples was $M = 37.43$ ($SD = 11.08$) and 36% ($SD = 29.84$) were female. Out of 339 studies, 22 (6%) reported findings from the general population, 268 (79%) investigated high-risk samples, and 42 (12%) studies confirmed a criterion A traumatic event on an individual basis, seven (2%) could not be classified due to insufficient information. The types of traumatic and aversive life events varied considerably across studies: serious illnesses (76 studies; 22%), war-related traumas (68; 20%), occupational traumas (59; 17%), natural disasters (28; 8%), accidents (17; 5%), civil violence (15; 4%), loss (9; 3%), child birth (5; 1%); aversive childhood experiences (4; 1%), and genocide (3; 1%). Forty stressors (12%) were classified as being 'short', while the majority of 233 stressors was rated as 'long' (69%). Table A.1 provided as Supplementary Material A displays the characteristics of all included samples along with sample sizes and effect sizes.

Associations with PTSD symptom severity

The results of the separate meta-analyses on the relationships between PTG, all resilience-related factors, and PTSD symptoms are displayed in Table 1. PTG demonstrated a weak positive relationship with PTSD symptom levels, $M(r) = .11$ (95% CI = .05 - .18). Of all resilience-related factors, SOC demonstrated the strongest negative relationship with PTSD symptoms, $M(r) = -.40$ [95% CI = (-.35) - (-.45)], which remained stable after the exclusion of one outlying sample, $M(r) = -.39$ [95% CI = (-.35) - (-.43)]. Indicated by non-overlapping CIs, SOC and PTSD symptoms showed a significantly stronger relationship than PTSD symptoms and trait-resilience, $M(r) = -.29$ [95% CI = (-.26) - (-.33)], internal LOC, $M(r) = -.24$ [95% CI = (-.16) - (-.33)], self-efficacy, $M(r) = -.23$ [95% CI = (-.17) - (-.29)], dispositional optimism, $M(r) = -.26$ [95% CI = (-.21) - (-.32)], and openness to experience, $M(r) = -.08$ [95% CI = (-.05) - (-.11)]. However, the CIs of SOC and hardiness, $M(r) = -.33$ [95% CI = (-.26) - (-.41)], as well as the CIs of SOC and sense of mastery, $M(r) = -.30$ [95% CI = (-.20) - (-.40)], overlapped. In case of sense of mastery, the exclusion of one outlying sample resulted in a significantly smaller association with PTSD symptoms compared to SOC, $M(r) = -.24$ [95% CI = (-.20) - (-.29)]. As expected, the extent of an external LOC demonstrated a positive relationship with PTSD symptoms, $M(r) = .34$ (95% CI = .23 - .44). In terms of absolute values, the CIs of SOC and external LOC overlapped, even after the exclusion of one outlier, $M(r) = .29$ (95% CI = .21 - .37).

The majority of the meta-analyses revealed a significant amount of remaining heterogeneity even after outlier exclusion. Homogeneous results, which would allow for the generalizability of findings to the population, were only found for sense of mastery (after the exclusion of one outlier, $I^2 = 0$) and for

openness to experience (I^2 = 23% or 0% after the exclusion of one outlier). Medium heterogeneity was evident for external LOC (I^2 = 61%) and dispositional optimism (I^2 = 73%) after outlier exclusion.

Table 1. Results of the main meta-analyses on the relationships between PTSD symptom severity and relevant resilience-related factors

Analysis	n	k	$M(r)$	τ^2	95%CI$_l$	95%CI$_u$	Q	df	$p(Q)$	I^2
PTG	18,595	47	.11**	.05	.05	.18	11539.31	46	< .001	96.87
Excluding outliers	16,594	46	.14**	.03	.09	.19	557.92	45	< .001	91.61
Sense of coherence	10,958	44	-.40**	.02	-.35	-.45	697.51	43	< .001	89.75
Excluding outliers	10,838	43	-.39**	.02	-.35	-.43	518.06	42	< .001	85.35
Trait-resilience	44,575	119	-.29**	.04	-.26	-.33	2853.71	118	< .001	94.93
Excluding outliers	44,297	117	-.30**	.03	-.26	-.33	2488.40	116	< .001	93.97
Hardiness	5,120	15	-.33**	.02	-.26	-.41	85.16	14	< .001	88.21
Excluding outliers	4,988	14	-.36**	.01	-.30	-.43	63.37	13	< .001	83.47
Internal LOC	3,797	15	-.24**	.02	-.16	-.33	96.33	14	< .001	86.31
External LOC	2,380	8	.34**	.01	.23	.44	48.36	7	< .001	80.72
Excluding outliers	2,250	7	.29**	.01	.21	.37	22.84	6	< .001	61.16
Self-efficacy	43,353	29	-.23**	.02	-.29	-.18	154.87	28	< .001	94.18
Sense of mastery	2,251	9	-.30**	.02	-.20	-.40	119.46	8	< .001	84.94
Excluding outliers	1,689	8	-.24**	.03	-.20	-.29	7.81	7	.350	0.02
Optimism	10,443	34	-.26**	.02	-.21	-.32	250.63	33	< .001	88.52
Excluding outliers	9,978	32	-.30**	.01	-.26	-.33	123.48	31	< .001	73.20
Openness	4,718	13	-.08**	.00	-.05	-.11	24.26	12	.019	21.50
Excluding outliers	4,621	12	-.07**	.00	-.04	-.10	8.47	11	.671	0.00

Note. PTG = posttraumatic growth, LOC = locus of control, k = number of samples; $M(r)$ = mean (correlation coefficient); τ^2 = estimated variance in the population; p = significance value of $M(r)$; CI$_l$ and CI$_u$ = lower and

Table 1 (continued).

upper boundaries of the 95% confidence interval; Q = Q statistic; df = degrees of freedom of Q statistic; $p(Q)$ = significance value of Q statistic; I^2 = index of heterogeneity (as a percentage).
** marks significant results ($p < .001$) for $M(r)$.

Relationships between posttraumatic growth and resilience-related factors

Table 2 presents the results of the meta-analyses on the bivariate correlations between PTG and all resilience-related factors as well as their intercorrelations. Of 45 possible intercorrelations only 25 could be estimated based on the included studies. Moreover, in three cases only one correlation coefficient was available precluding a meta-analysis. With respect to PTG, all resilience-related factors except for SOM, $M(r)$ = -.03 [95% CI = (-.19) – .12], showed at least a small – not yet significant – to medium positive relationship ranging from $M(r_{PTG/SOC})$ = .06 (p = .348) to $M(r_{PTG/self-efficacy})$ = .33 ($p < .001$). With respect to the interrelationships between resilience-related concepts, all factors, except for external LOC, showed a positive correlation ranging from $M(r_{openness/optimism})$ = .25 ($p < .001$) to $M(r_{self-efficacy/trait-resilience})$ =.64 ($p < .001$).

Table 2. Bivariate correlations between resilience-related factors based on meta-analyses

	1	2	3	4	5	6	7	8	9	10
Posttraumatic growth (1)	*162*									
Sense of coherence (2)	.06 (9)	*86*								
Trait-resilience (3)	.29** (55)	.52** (4)	*167*							
Hardiness (4)	.22* (4)	-	-	*20*						
Internal LOC (5)	.14** (4)	.51** (2)	.44** (2)	-	*31*					
External LOC (6)	.02 (3)	-.53** (2)	-.19* (3)	-.35 (1)	-.26** (2)	*31*				
Self-efficacy (7)	.33** (13)	-	.64** (2)	.36 (1)	.63** (2)	-.08 (1)	*37*			
Sense of mastery (8)	-.03 (3)	-	.51** (2)	-	-	-	-	*41*		
Optimism (9)	.19** (31)	-	.50** (3)	-	-	-	-	.50** (3)	*65*	
Openness (10)	.21** (20)	-	.33** (6)	-	-	-	-	-	.25** (4)	*41*

Note. LOC = locus of control. All correlation coefficients represent results of meta-analyses on the relationships between different resilience-related factors. The number in brackets contains the number of studies (k) that

Table 2 (continued).

contributed to each meta-analysis. Correlation coefficients in grey indicate the availability of only one bivariate correlation. The diagonal contains the number of studies investigating each resilience-related factor.
* marks significant results ($p < .05$) for *M(r)*.
** marks significant results ($p < .001$) for *M(r)*.

Empirical tests of conceptual overlaps

Based on theoretical assumptions described in the introduction, the potential conceptual overlap between different resilience-related concepts was examined comparing meta-analyses on single resilience-related factors with PTSD symptoms to meta-analyses that combine different factors (see Table 3). A joint meta-analysis on trait-resilience and hardiness ($94\% \leq I^2 \geq 96\%$) did not result in a significant increase in heterogeneity compared to single analyses on trait-resilience ($93\% \leq I^2 \geq 96\%$) and hardiness ($77\% \leq I^2 \geq 96\%$). Thus, for all subsequent analyses trait-resilience and hardiness were treated as a single resilience-related factor.

Moreover, also the joint analysis of internal and (inverted) external LOC did not result in a significant increase in heterogeneity [$LOC_{internal}$: 76% - 96%; $LOC_{external}$: 56% - 96%; vs. $LOC_{combined}$: 78% - 95%]. Building on theoretical considerations, the joint analysis of LOC was further complemented by sense of mastery, which again, did not result in a significant increase of heterogeneity [$LOC_{combined}$: 78% - 95%; sense of mastery: 69% - 96%; LOC/sense of $mastery_{combined}$: 79% - 94%]. Thus, for all further analyses internal and external LOC were analyzed together with sense of mastery constituting a single factor of control beliefs.

Table 3. Empirical tests of expected conceptual overlaps between different resilience-related factors – comparison of single and combined analyses

Analysis	*k*	*M(r)*	τ^2	95%-CI		*Q*	I^2	95%-CI
Trait-resilience	123	-.29**	.04	-.26	-.33	2890.70**	94.89	93.33 - 96.11
Excluding outliers	121	-.30**	.03	-.26	-.33	2524.82**	93.95	92.09 - 95.45
Hardiness	15	-.33**	.02	-.26	-.41	85.16**	88.21	77.32 - 96.04
Excluding outliers	14	-.36**	.01	-.30	-.43	63.37**	83.47	67.48 - 95.14
Trait-resilience + Hardiness	138	-.30**	.03	-.27	-.33	2940.43**	94.68	93.08 - 95.88
Excluding outliers	135	-.30**	.03	-.27	-.33	2593.95**	93.70	91.83 - 95.17
Internal LOC	15	-.24**	.02	-.16	-.33	96.33**	86.31	75.89 - 96.22

Table 3 (continued).

	k	M(r)	τ²	CI_l	CI_u	Q	I²	
External LOC	8	.34**	.01	.23	.44	48.36**	80.72	56.02 - 95.95
Excluding outliers	7	.29**	.01	.21	.37	22.84**	61.16	18.18 - 93.51
Internal + external LOC	23	-.28**	.02	-.21	-.34	149.18**	86.40	77.71 - 94.86
Excluding outliers	22	-.26**	.02	-.20	-.33	119.79**	83.06	72.47 - 94.29
Sense of mastery	9	-.30**	.02	-.20	-40	119.46**	84.94	69.23 - 95.71
Excluding outliers	8	-.24**	.03	-.20	-.29	7.81	0.02	0.00 - 82.68
Internal + external LOC + SOM	32	-.28**	.02	-.23	-.34	306.56**	86.44	78.97 - 93.55
Excluding outliers	30	-.26**	.01	-.21	-.31	128.03**	75.91	64.25 - 90.75

Note. LOC = locus of control, SOM = sense of mastery; k = number of samples; $M(r)$ = mean (correlation coefficient); τ^2 = estimated variance in the population; p = significance value of $M(r)$; CI$_l$ and CI$_u$ = lower and upper boundaries of the 95% confidence interval; Q = Q statistic; df = degrees of freedom of Q statistic; $p(Q)$ = significance value of Q statistic; I^2 = index of heterogeneity (as a percentage).
** marks significant results ($p < .001$) for $M(r)$.

Results of the moderator analyses

Since the exclusion of outliers did not result in a substantial reduction of heterogeneity for most of the resilience-related concepts, the moderator analyses for the relationship between all resilience-related concepts and PTSD symptoms as primary outcome were conducted including the outliers. In case of significant moderating effects, all analyses were repeated without the outliers. Results of the moderator analyses are reported in the main manuscript if the analyses were sufficiently powered ($k \geq 5$ per moderator level) and if the respective variables demonstrated a significant moderating effect. Results for all potential moderator effects (including non-significant results) are reported in Supplementary Materials B and C.

Sample age

For SOC, older samples were associated with a stronger negative association between SOC and PTSD symptoms, $QM(1) = 7.09$, $p = .008$, $R^2 = .18$, which remained significant after excluding one outlier, $QM(1) = 3.94$, $p = .048$, $R^2 = .10$. The same result pattern was evident for trait-resilience, $QM(1) = 12.29$, $p < .001$, $\Delta R^2 = .12$; excluding two outliers: $QM(1) = 11.55$, $p < .001$, $R^2 = .11$; and sense of mastery, $QM(1) = 116.69$, $p < .001$, $R^2 = 1.00$; excluding one outlier: $QM(1) = 5.64$, $p = .018$, $R^2 = 1.00$; and dispositional optimism, $QM(1) = 5.50$, $p = .019$, $R^2 = .21$; excluding two outliers: $QM(1) = 5.77$, p

= .016, R^2 = .27. Conversely, in case of internal LOC older samples were linked to smaller negative correlations, $QM(1) = 3.94$, $p = .047$, $R^2 = .21$. Combining trait-resilience and hardiness, older samples were again linked to stronger negative correlations, $QM(1) = 11.59$, $p < .001$, $R^2 = .10$; excluding three outliers: $QM(1) = 12.40$, $p < .001$, $R^2 = .11$.

Gender imbalance

Gender imbalance per sample influenced the mean estimated effect size only in the case of external LOC: Samples containing more female participants were associated with a weaker positive relationship between external LOC and PTSD symptoms, $QM(1) = 8.56$, $p = .003$, $R^2 = .64$. However, this effect disappeared after excluding one outlying sample, $QM(1) = 0.05$, $p < .001$, $R^2 = .02$. The same applied to sense of mastery, $QM(1) = 4.51$, $p = .034$, $\Delta R^2 = .45$; excluding one outlier: $QM(1) = 0.02$, $p = .888$, $R^2 = .00$. Correspondingly, for the combined analysis of internal/(inverted) external LOC and sense of mastery, the initially significant moderating effect of gender, $QM(1) = 7.10$, $p < .008$, $R^2 = .27$; disappeared after excluding the outliers: $QM(1) = 2.21$, $p = .137$, $R^2 = .19$.

Trauma types

The types of traumatic events that could be investigated as moderators based on a sufficient number of studies, i.e., accidents, civil violence, natural disasters, occupational traumas, and war experiences, had no impact on the mean estimated effect size for any of the resilience-related factors.

The nature of trauma (accidental vs. interpersonal vs. medical) only had a significant impact on the mean estimated effect size for dispositional optimism. Significant differences were found between accidental, $M(r) = -.20$ [95% CI = (-.10) – (-.299)] and medical traumas, $M(r) = -.37$ [95% CI = (-.30) - (-.44)]. However, this difference disappeared after excluding two outliers, which resulted in an increased estimation of the mean effect size for accidental traumas, $M(r) = -.25$ [95% CI = (-.19) – (-.31)].

Duration of exposure

The duration of exposure to the traumatic event (long vs. short) had no impact on the mean estimated relationship for any of the resilience-related factors.

Study design

There was no moderating effect of study design (cross-sectional vs. longitudinal) on the relationship between PTSD and all resilience-related factors.

Type of population

For type of population (general vs. high-risk populations vs. samples that ensured a criterion A trauma on an individual basis) there was also no significant moderating effect.

Meta-analytical regression models

Table 4 presents the results of meta-analytical regression models contrasting the specific amounts of variance accounted for by different resilience-related factors. As SOC demonstrated the strongest bivariate relationship with PTSD symptoms, we tested whether other resilience-related factors explained an incremental amount of variance in PTSD symptoms beyond SOC. Meta-analytical correlations between SOC and other concepts were only available for trait-resilience/hardiness, $M(r) = .52$ ($p < .001$), and LOC/sense of mastery, $M(r) = .52$ ($p < .001$). Analyzing SOC and trait-resilience/hardiness in a joint model did not demonstrate a significant incremental validity of trait-resilience/hardiness, $\Delta R^2 = .01$, $F(1; 107) = 1.35$, $p = .247$, while SOC uniquely accounted for 8% of the variance in PTSD symptoms, $F(1; 107) = 10.92$, $p = .001$. However, both factors shared 8% of the variance in PTSD symptoms.

The same analysis was conducted for LOC/sense of mastery and again, did not result in a significant amount of incremental validity of LOC/sense of mastery beyond SOC, $\Delta R^2 = .01$, $F(1; 107) = 1.05$, $p = .308$, while SOC accounted for a significant amount of variance even when controlling for LOC/sense of mastery, $\Delta R^2 = .09$, $F(1; 107) = 11.74$, $p < .001$. Together, SOC and LOC/sense of mastery shared 7% of the variance in PTSD symptoms.

Table 4. Results of the meta-analytical regression models for SOC, trait-resilience/hardiness, and locus of control/sense of mastery showing specific and shared proportions of variance in PTSD symptoms

	SOC		Res/Hard		SOC + Res/Hard						
	β	R^2	β	R^2	β_{SOC}	β_{res}	ΔR^2_{SOC}	ΔR^2_{Res}	ΔR^2_{shared}	$F_{SOC}(1; 107)$	$F_{res}(1; 107)$
All studies	-.40	.16	-.30	.09	-.34*	-.12	.08	.01	.08	10.92*	1.36
Excluding outliers	-.39	.15	-.30	.09	-.32*	-.13	.07	.01	.08	9.68*	1.58

	SOC		LOC/SOM		β_{SOC}	$\beta_{LOC/SOM}$	ΔR^2_{SOC}	$\Delta R^2_{LOC/SOM}$	ΔR^2_{shared}	$F_{soc}(1; 107)$	$F_{LOC/SOM}(1; 107)$
All studies	-.40	.16	-.28	.08	-.35*	-.11	.09	.01	.07	11.74**	1.05
Excluding outliers	-.39	.15	-.26	.07	-.35*	-.08	.09	.01	.06	11.42*	0.65

Note. SOC = sense of coherence; Res = trait-resilience; Hard = Hardiness; LOC = locus of control; SOM = sense of mastery; β = regression coefficient; ΔR^2 = incremental validity; ΔR^2_{shared} = explained variance; $F(df)$ = F-statistic with degrees of freedom (df) of the incremental validity.
** marks significant results ($p < .001$) for $\beta/\Delta R^2$.
* marks significant results ($p < .05$) for $\beta/\Delta R^2$.

Discussion

The meta-analytical investigation aimed to provide a comprehensive overview of the bivariate associations between different resilience-related concepts and posttraumatic outcomes. The current findings support the relevance of SOC as the most important correlate of PTSD symptoms after stressful life events and trauma. Not only did SOC demonstrate the strongest bivariate correlation with PTSD symptoms, $M(r) = -.40$ [95% CI = (-.35) - (-.45)], but also remained the only resilience-related concept that accounted for an incremental amount of variance in PTSD symptom levels when controlling for other factors (i.e., trait-resilience/hardiness and LOC/sense of mastery). Thus, variance in PTSD symptom severity explained by trait-resilience/hardiness and LOC/sense of mastery is shared by SOC making trait-resilience/hardiness redundant in a joint model.

Except for openness to experience, all resilience-related concepts showed a medium-sized (Cohen, 1988) negative bivariate relationship with PTSD symptoms ranging from $M(r_{self-efficacy}) = -.23$ to $M(r_{SOC}) = -.40$. Thereby, the current meta-analytical investigation is in line with our prior meta-analysis on the relationship between SOC and PTSD symptom levels (Schäfer et al., 2019), which also found a medium correlation, $M(r_{SOC}) = -.41$ [$M(r_{SOC}) = -.39$, if outliers were excluded]. However, contrary to our previous meta-analysis, the current meta-analytical investigation was able to demonstrate that SOC's association with PTSD symptoms is significantly stronger than those with other resilience-related concepts. Only for hardiness and external LOC the confidence intervals overlapped with those of SOC after the exclusion of outliers. However, when hardiness was combined with trait-resilience and external LOC was integrated with internal LOC and sense of mastery, the CIs no longer overlapped. Moreover, when hardiness was compared to SOC in a joint model with trait-resilience, both hardiness and trait-resilience no longer exhibited a significant incremental validity beyond SOC. The same applied to external LOC, when analyzed together with internal LOC and sense of mastery and contrasted with SOC. These findings are in line with previous studies on PTSD symptoms and general mental health problems that investigated SOC and other resilience-related concepts simultaneously (Grevenstein, Aguilar-Raab, et al., 2016; Grevenstein, Bluemke, & Kroeninger-Jungaberle, 2016; Streb et al., 2014) and further underline SOC's role as most important correlate of PTSD symptom levels. For example, in a sample of paramedics, Streb et al. (2014) investigated the association between SOC levels, trait-resilience, and PTSD symptoms and found no incremental validity of trait-resilience beyond SOC in a joint model.

Another important goal of the current meta-analytical investigation was to establish the conceptual overlap between different resilience-related concepts on an empirical basis. Initially, we aimed to analyze the associations between these concepts based on meta-analyses of bivariate correlation coefficients. However, there was only a small number of studies investigating more than one resilience-related concept and an even smaller number of publications that reported intercorrelations between those factors, resulting in meta-analyses comprising only a small number of samples ($k \leq 6$). Therefore, we decided to base our test of conceptual overlap on increases in heterogeneity when two or more resilience-related concepts were entered in a joint meta-analysis model. Thereby, we were able to integrate the

resilience-related concepts of trait-resilience and hardiness, whose conceptual distinctness has been questioned in previous research (Maltby, Day, & Hall, 2015). This was further underlined by studies that used the same instrument *Dispositional Resilience Scale* (DRS) (Bartone, 1991) for either the assessment of hardiness or trait-resilience and a meta-analysis on the relationship between trait-resilience and mental health that included studies using the DRS as a resilience measure (Hu et al., 2015). In general, as opposed to SOC grounding on the theory of salutogenesis (Antonovsky, 1979, 1987), distinct theoretical frameworks for trait-resilience and/or hardiness are still missing (Windle et al., 2011). This lack of conceptual clarity makes it difficult to analyze SOC's incremental validity more detailed, since specific operationalizations vary between different measures of trait-resilience. Thus, SOC may exhibit differing increments depending on the assessment of trait-resilience and/or hardiness.

According to our findings, the two LOC dimensions - internality and externality - constituted further concepts that could be integrated. Even though recent research proposes the assessment of LOC as a multifaceted construct and demonstrates a stronger relationship between external LOC and mental health (Gore et al., 2016), in our analyses the CIs of internal and (inverted) external LOC overlapped substantially and a joint analysis of both concepts did not result in a significant increase of heterogeneity. Moreover, the relevance of control beliefs is also of major importance in the concept of sense of mastery. Given this theoretical overlap, we investigated changes in heterogeneity resulting from the combination of [internal and (inverted) external] LOC and sense of mastery, which again did not result in significantly increased heterogeneity. Thus, based on our findings, one might argue that the belief that events are controllable by one's actions (and not predominantly dependent on factors beyond one's influence) (Rotter, 1966) shows a significant negative association with PTSD symptom levels, $M(r) = -.28$ [95% CI = (-.23) - (-.34)], but that the specific type of assessment (i.e., internal, external control beliefs or mastery beliefs) has no impact on its magnitude. Furthermore, results from our regression models suggest that the relevant amount of variance in control beliefs is already accounted for by the assessment of SOC. Developing the concept of salutogenesis (Antonovsky, 1979, 1987), Antonovsky had been aware of the LOC concept (Rotter, 1966) and it may have inspired the SOC component *manageability*, defined as an individual's perception of having the necessary (internal and external) resources to cope with life's demands and stresses, and the subjective expectation that one will be able to overcome adversity by using these resources (Mittelmark et al., 2017). Especially the latter shows a strong overlap with the LOC concept. However, while the SOC concept stresses perceived resources to initiate successful coping processes, the concept of LOC focusses on behavioral control over these processes and outcomes. Thus, having an internal LOC is not related to possessing specific resources and expecting a beneficial outcome, but describes the assumption that potential outcomes could be controlled by oneself. This may correspond to high levels of *manageability* but does not necessary need to. The current findings suggest that SOC already comprises the relevant aspects of control included in the LOC concept. However, future studies need to address this question using factor analyses.

Interestingly, we found a significant moderating effect of age on the relationships between PTSD symptoms and SOC, trait-resilience, internal LOC, dispositional optimism as well as the combination of trait-resilience and hardiness. Samples' mean age accounted for 10% (SOC and trait-resilience/hardiness) to 100% (sense of mastery) of the variance in effect sizes. Except for internal LOC where older samples were linked to weaker associations, all resilience-related concepts demonstrated stronger negative relationships with growing sample age. With respect to SOC, this is in line with the theory of salutogenesis, which conceptualizes SOC as growing and stabilizing over the lifespan [Mittelmark et al. (2017); but see: P. M. Smith, Breslin and Beato (2003); Vastamäki, Moser and Paul (2009)]. According to the salutogenesis framework, SOC increases until the age of 30 at which point it is assumed to stabilize [Mittelmark et al. (2017); but see: Nilsson, Holmgren, Stegmayr and Westman (2003)]. Thus, older participants may have already developed a higher and more stable SOC, which in turn, shows a stronger relationship with PTSD symptoms. Such an increasing and stabilizing process over the lifespan has also been described for LOC (Hale & Cochran, 1986), while self-efficacy seems to remain unaffected by age (Trouillet, Gana, Lourel, & Fort, 2009). Recent studies on the stability of trait-resilience and hardiness demonstrated stability over time, albeit using shorter observation periods of nine months (Van Der Meulen, van Veldhoven, & Van Der Velden, 2019) and three years (Hystad, Olsen, Espevik, & Säfvenbom, 2015). Studies on the temporal stability of dispositional optimism are rare and describe low to medium levels of stability (Segerstrom, 2007) as well as potential effects of health on optimism in older adults (Chopik, Kim, & Smith, 2015). The current results do not allow for strong conclusions concerning the impact of age on the associations between resilience-related concepts and PTSD symptoms. However, they identified sample age as a relevant factor requiring further study using a lifespan approach. Future studies should also address the question why internal LOC exhibited an inverse pattern, showing weaker relationships in older samples.

In addition, we investigated PTG as potential secondary posttraumatic outcome [see Schubert et al. (2016) for a detailed discussion of the role of PTG]. Our findings are partly in line with a previous meta-analysis (k = 42) on the relationship between PTG and PTSD symptom severity (Shakespeare-Finch & Lurie-Beck, 2014), which found a positive linear relationship, $M(r)$ = .32 (95% CI = .30 - .33). However, the effect size obtained by our meta-analysis is significantly smaller, $M(r)$ = .11 (95% CI = .05 - .18). Interestingly, both analyses used similar inclusion criteria, except for the fact that our analysis required the additional assessment of a resilience-related concept resulting in the exclusion of studies that solely assessed PTG and PTSD symptoms. Despite this discrepancy, both meta-analyses demonstrated a positive linear relationship between PTG and PTSD symptoms that may reflect trauma survivors attempt to reassure themselves that posttraumatic outcomes are less catastrophic than they think and to deal with existing PTSD symptoms (Kleim & Ehlers, 2009). Moreover, in presence of PTSD symptoms, PTG may also have an illusory and rather self-deceptive side linked to denial, avoidance, and wishful thinking (Maercker & Zoellner, 2004). Interestingly, the resilience-related factors showed a small to medium sized relationship with PTG, whereby SOC and sense of mastery demonstrated particular weak

associations and trait-resilience and self-efficacy demonstrated the numerically largest correlations. Furthermore, with respect to PTG, our results underline that it is not sufficient to investigate PTG as posttraumatic cognitive outcome. Conceptualizing both as post-trauma outcomes, SOC accounts for a larger amount of variance in PTSD symptom levels compared to PTG (16% vs. 1%), and as indicated by a post-hoc analysis, PTG demonstrates no incremental validity beyond SOC in predicting PTSD symptoms when analyzed in a joint model, $\Delta R^2 = .02$, $F(1; 107) = 2.52$, $p = .115$. Thus, our findings indicate that SOC shows a stronger overlap with PTSD symptoms than PTG and future research need to clarify PTG's role as a relevant posttraumatic cognitive outcome in the context of other concepts.

One may criticize that all types of samples were included in our meta-analytical investigation, i.e., samples from the general population (e.g., student samples), high-risk samples (e.g., communities that have been exposed to a natural disaster), and survivors of traumatic events that were ensured in each participant. However, this decision was mostly influenced by the high global lifetime prevalence of traumatic event in the general population (Benjet et al., 2016; Kessler et al., 2017). Thus, even when assessing samples from the general population, studies include a substantial subsample of traumatized individuals. Moreover, only a very small proportion of studies (42 out of 339 samples) ensured a traumatic event according to criterion A of DSM-IV-TR (American Psychiatric Association, 2000) or DSM-5 (American Psychiatric Association, 2013) on an individual basis. Another 268 reported findings from samples that were at risk for traumatization due to the experience of an aversive life-event (e.g., a serious illness of oneself or others). However, here criterion A might not have been fulfilled for all participants. Interestingly, for none of the resilience-related factors the type of population showed a significant moderating effect on the magnitude of the relationship. This may suggest that the type of population has no impact on the relationship between different resilience-related concepts and PTSD symptoms. However, this conclusion is tentative, since samples of traumatized individuals and from the general population were rare for all resilience-related concepts except for trait-resilience.

Limitations

Some limitations have to be taken into account interpreting the current meta-analytical investigation. First, the findings are limited by their cross-sectional character. Given the lack of longitudinal studies and their low comparability (e.g., due to varying periods of assessment), all analyses relied on cross-sectional associations. When correlations were provided for different points in time, we decided to calculate weighted averages to include them in the meta-analyses. To control for the influence of longitudinal versus cross-sectional studies, we performed a moderator analysis, which did not reveal a significant impact of study design on the estimated population effect sizes for all resilience-related concepts. However, the cross-sectional nature of the studies prohibits inferences on temporal causality, which are of great relevance for the development of clinical practice and interventions. Based on the current findings, one might also argue that levels of resilience-related factors are decreased due to current mental health problems and that low levels of resilience-related factors might merely mirror

severe PTSD symptoms without any causal influence of these concepts on PTSD development and course. However, this criticism has also been raised regarding PTG, which has been conceptualized as an attempt to make sense of perceived strains caused by PTSD (Kleim & Ehlers, 2009). We found only small to medium sized, mostly positive relationships between resilience-related concepts and PTG, while resilience-related concepts were negatively associated with PTSD symptom levels, challenging the view that both are simply a reflection of PTSD symptoms.

Second, a further limitation is related to the sample size. Overall, the current meta-analytical investigation is based on an exceptionally large sample comprising 142,468 participants. However, the number of included studies and thereby the number of individuals contributing to each meta-analysis varied between different resilience-related concepts resulting in rather small total samples [e.g., $n = 2,251$ (or $n = 1,689$ after the exclusion of outliers) for sense of mastery] in contrast to very large samples such as in case of trait-resilience ($n = 44,575$). These differences in sample size result in differences in statistical power (Valentine, Pigott, & Rothstein, 2010) and impact on the precision of each estimation, which is reflected by large variance in CI sizes.

From a theoretical perspective, the focus on linear relationships, i.e., zero-order correlations, could also be perceived as problematic. For some concepts including SOC (Kazmierczak, Strelau, & Zawadzki, 2012), self-efficacy (Nygaard, Johansen, Siqveland, Hussain, & Heir, 2017), and PTG (Mattson, James, & Engdahl, 2018), studies also found or - in case of self-efficacy (Nygaard, Hussain, Siqveland, & Heir, 2016) discussed - curvilinear relationships between levels of resilience-related factors and PTSD symptoms or changes in PTSD symptom severity over time. Inspired by schema theory (Horowitz, 1986), such studies mostly assume that individuals with extremely high levels of resilience-related factors (e.g., extremely high levels of SOC or sense of mastery) may be at higher risk for the development of PTSD, as traumatic events cannot easily be integrated into rigid existing schemas (Kazmierczak et al., 2012). However, for all resilience-related concepts included in our analyses, such relationships were only investigated in a small number of studies precluding meta-analyses. In case of PTG a substantial number of studies also reported curvilinear associations [for a detailed discussion on the relationship between PTG and PTSD symptoms, see Shakespeare-Finch and Lurie-Beck (2014)]. However, we decided to focus on linear relationships to ensure the comparability with other concepts of interest, where linear relationships were not investigated.

Future research

Research on resilience would profit from studies that allow for temporal causal inferences and that provide insights into underlying processes. In this context, studies using experience sampling methods (Palmier-Claus, Haddock, & Varese, 2019) as an intensive data collection technique may provide further insights into the onset and development of psychopathological symptoms after traumatic events. The use of these techniques may also allow for the analyses of the complex interplay between resilience-related cognitive concepts and context variables. Particularly in case of the salutogenesis framework

(Antonovsky, 1979, 1987) such studies may firstly provide the opportunity to test the process-related assumptions regarding SOC's modulatory role in determining an individual's position on the continuum between *ease* and *dis-ease*. For the first time, this would enable to test Antonovsky's model (1979, 1987) beyond simple relationships.

Such an empirical test be of great importance since our meta-analytical investigations demonstrated a particularly strong cross-sectional bivariate relationship between SOC and PTSD symptoms, which significantly exceeded the associations found for other resilience-related concepts. Given SOC's incremental validity beyond other resilience-related concepts, future research should focus on SOC and examine its role in PTSD development and course in greater depth. Especially in case of SOC longitudinal studies are rare and often do not assess pre-trauma SOC levels (Hepp et al., 2008; Moergeli, Wittmann, & Schnyder, 2012; Schnyder et al., 2001). To our knowledge, only one study assessed pre-trauma SOC in pregnant women and demonstrated its predictive validity for PTSD symptoms following pregnancy loss (Engelhard, Van den Hout, & Vlaeyen, 2003). In this study the impact of SOC on PTSD symptoms was mediated by social support, in line with the salutogenesis framework (Antonovsky, 1979, 1987), which conceptualizes social support as a generalized resistance resource (Mittelmark et al., 2017). However, future studies should assess pre- and post-trauma SOC levels - using both the well-established scales by Antonovsky (1993) and the new scales developed by Bachem and Maercker (2016) - as well as PTSD symptoms over a longer time to allow for inferences on temporal causality. These studies should also investigate different types of trauma (i.e., interpersonal vs. accidental traumas or type I vs. type II traumas). It is plausible to assume that the association between SOC and PTSD symptoms varies depending on the type of trauma, as type of trauma has been found to impact on the development and course of PTSD (Kessler et al., 2017). Following the 'shattered assumptions' approach (Janoff-Bulman, 1989) traumatic events can change three fundamental assumptions: the overall benevolence of the world, meaningfulness of the world, and one's perceived self-worth. Thus, according to this theory, SOC as a global orientation might be particularly relevant to traumatic experiences that strongly change one's fundamental assumptions (i.e., interpersonal traumas) (Lim, Adams, & Lilly, 2012). Studies investigating these differences should not only concentrate on linear but also on curvilinear relationships to comprehensively characterize the relationship between SOC and PTSD symptom levels over time.

Prospective studies would also be relevant from a treatment point of view. In this context, SOC might also be of interest as a treatment outcome (Reyes, Kearney, Lee, Isla, & Estrada, 2018), since studies already demonstrated changes in SOC levels as a consequence of trauma therapy (Lundqvist, Svedin, Hansson, & Broman, 2006). If longitudinal studies could demonstrate that high SOC levels represent a protective factor against the development of PTSD, psychotherapy should aim to normalize SOC levels to lower the risk of re-developing PTSD in case of exposure to another traumatic event.

Conclusion

For the first time the current meta-analytical investigation based on data of 142,468 participants firstly assessed the cross-sectional relationship between eight resilience-related concepts - namely sense of coherence, trait-resilience, hardiness, (internal and external) locus of control, self-efficacy, sense of mastery, dispositional optimism, and openness to experience - and PTSD symptoms and posttraumatic growth. While these resilience-related concepts, with the exception of sense of mastery, exhibited small positive relationships with PTG, they showed substantial negative relationships with PTSD symptoms. Compared to all resilience-related concepts, sense of coherence was found to be the strongest correlate of PTSD symptoms, $M(r) = -.40$. Elaborating on their theoretical overlap, meta-analyses demonstrated that the concepts of trait-resilience and hardiness could be integrated without substantial increases of heterogeneity. The same applied to internal and (inverted) external locus of control and sense of mastery, which together comprised a control factor. However, in meta-analytical regression models combining these concepts, none of them exhibited incremental validity beyond sense of coherence. Thus, sense of coherence was found to be the most relevant cross-sectional correlate of PTSD symptoms, accounting for 16% of the variance. Future prospective studies need to further investigate the nature of this relationship to clarify SOC's potential role as pre-trauma risk factor and/or relevant posttraumatic outcome.

Abbreviations

CD: Cook's distances; CI: confidence interval; COVRATIO: covariance ratios; DSM-IV-TR: Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; DO: dispositional optimism; DSM-5: Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition; DSR: Dispositional Resilience Scale; OE: openness to experience; PTG: posttraumatic growth; PTSD: posttraumatic stress disorder; LOC: locus of control; SDR: studentized deleted residuals; SE: self-efficacy; SOC: sense of coherence; SOM: sense of mastery.

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Supplementary Material

Supplementary Material A	Study overview - Table containing all included studies and their sample characteristics
Supplementary Material B	Detailed results of the meta-analyses on the bivariate relationship between symptoms of posttraumatic stress disorder and different health-benefitting factors
Supplementary Material B	Detailed results of the meta-analyses on the bivariate relationship between symptoms of posttraumatic stress disorder and combined health-benefitting factors
Supplementary Material D	Reference list of studies included in the meta-analyses

For Supplementary Material provided in the Open Science Framework use the following link or QR code:

Link: https://osf.io/7pdya/?view_only=4995b431c38140ba85542448ef474a8f

QR-Code:

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