Mental resilience in the Corona lockdown:
First empirical insights from Europe

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Abstract

Background

The current Corona pandemic is not only a threat to physical health. First data from China and Europe indicate that symptoms of anxiety and depression and perceptions of stress rise significantly as a consequence of the pandemic. There are also anecdotal reports of increased domestic violence, divorce, and suicide rates. Hence, the Corona crisis is also a mental health crisis. There is urgent need for knowledge about factors that can protect mental health (resilience factors) in this world-wide crisis, which is different in nature from other crises that have so far been studied in resilience research.

Methods

Potential resilience factors, exposure to Corona-specific and general stressors, as well as internalizing symptoms were assessed online in N=5000 adult Europeans. Resilience, as an outcome, was conceptualized as good mental health despite stressor exposure and measured as the inverse residual between actual and predicted symptom total score. Preregistered hypotheses (osf.io/r6btn) were tested with multiple regression models and mediation analyses.

Results

Results confirmed our primary hypothesis that positive appraisal style (PAS) is positively associated with resilience ($p<0.001$). The resilience factor PAS also mediated the positive association between perceived social support (PSS) and resilience ($p<0.001$). In comparison with other resilience factors, positive appraisal specifically of the consequences of the Corona crisis was the single strongest factor.

Conclusions

This research identifies modifiable protective factors that can be targeted by public mental health efforts. Future work will have to identify potential group differences in the effectiveness of these resilience factors, for improved prevention planning.

Pandemics can induce high levels of stress and result in mental health problems, such as pathological anxiety, post-traumatic stress, or depression.[1–3] Measures of social distancing and quarantine aimed to curtail the spread of the pathogen likely have additional detrimental psychological effects.[4] In the current pandemic, significant impairments of well-being and mental health in the general population as well as among frontline workers have already been reported in China.[5–8] First data from European countries confirm this picture (https://youngminds.org.uk/media/3708/coronavirus-report_march2020.pdf; https://cosmo.sciencemediacenter.de/). The general media also report about perceived increases in domestic violence, divorce, suicide and other psychosocial consequences (see also *9*). Unfortunately, during curfews and other movement and contact restrictions, professional psychological or psychiatric help is even more difficult to obtain than in normal times.[10]

Resilience research aims to identify the social, psychological and biological factors that protect individuals from developing mental health problems when confronted with adversity.[11] Most knowledge about resilience factors stems from individual-level traumata or challenges or from commonly experienced catastrophes such as natural disasters or terror attacks,[11–13] but little is known specifically about resilience factors effective in pandemics.[4] Such knowledge, however, is urgently needed in the current crisis as a basis for the development of effective mental health protection measures.

We are conducting a global internet-based cross-sectional survey (DynaCORE-C, www.dynacore.info) assessing potential resilience factors and their influence on resilience, the latter defined as the outcome of good mental health despite stressor exposure. Our primary hypothesis is that positive appraisal style (PAS) is a resilience factor, that is, will be positively associated with outcome-based resilience. PAS is a new construct developed based on positive appraisal style theory of resilience (PASTOR)[14] and predictive of outcome-based resilience in own, yet unpublished prospective-longitudinal studies (Supplementary Appendix, section 2.2.2). The survey started on March 22nd, when measures of quarantine, social distancing, or curfew were already in place in many European countries. On April 1st, the survey included its 5000st European participant that had fully completed the survey questionnaire. At this time, 5250 participants in total had completed the questionnaire and an additional 3009 participants had provided incomplete data (of which 869 from Europe). In the beginning, the survey questionnaire was available in English and German; by April 1st, ten further languages were available. We here report the preregistered first interim analysis of the 5000 complete European data sets (see osf.io/r6btn).

Methods

Sample

Participants (all genders, older than 18 years, no other in- or exclusion criteria) are recruited using a snowball sampling strategy. Subjects give informed consent electronically. The study was approved by the ethics committee of the State Medical Board of Rhineland-Palatinate, Germany, and is conducted in accordance with the Declaration of Helsinki.

There is no initially planned sample size and the study is still being expanded to further language areas. A decision about the final timeframe of recruitment will be taken at the time when official general movement or contact restrictions are terminated in a given country.

For sample characteristics of the first 5000 participants reporting a European country of residence and providing complete data (n=4997 after data cleaning), see Table S1. The sample contains a large proportion of women, Germans, and students or employees working in research and/or education. For incomplete European questionnaire data (n=868 after cleaning), see Suppl. 4.

Independent variables (resilience factors) and covariates

Information on the survey questionnaire, derived variables and indices, and socio-demographic and health covariates are given in Suppl. 1 and Tables S2 and S3. Shortly after the start of the survey, a question on past or present diagnosed mental health conditions was added. Among the n=4485 European participants with complete data interrogated about a diagnosis, 23.2% affirmed the question (Table S4). Independent variables for which we hypothesized directed associations with resilience based on existing literature[11,12] and own ongoing, unpublished work are: PAS (primary hypothesis), perceived social support, a perceived increase in social support during the Corona crisis, optimism, perceived general self-efficacy, perceived good stress recovery, neuroticism (inverse), behavioral coping style, and positive appraisal specifically of the Corona crisis (PAC) (key secondary hypotheses). We also pre-formulated two mediation hypotheses. For details, see Suppl. 2.2 and Table S5. For the development of the PAS instrument specifically, see Suppl. 2.2.2.

Assessment of stressors

The questionnaire includes a detailed assessment of stressors participants have been exposed to in the past two weeks. Measurement of stressor exposure is an important, though often neglected ingredient of resilience research, because resilience is only a meaningful concept when adversity is present (see below)[11,15]. We differentiate between exposure to general stressors (E_G), as they may also occur in normal times but may well be exacerbated by the current crisis (eleven broad classes of stressors such as family conflicts, physical health problems, or financial problems), as well as exposure to stressors specific for the Corona crisis (E_S) (29 items such as COVID-19 symptoms, belonging to a risk group for serious COVID-19 symptoms, loss of social contact, or problems arranging childcare). We quantify E_G and E_S by the sum count of the reported stressors, weighted by their rated severity, and also combine both stressor categories into a common index E_C by averaging the z-normalized E_G and E_S sum counts. See Suppl. 2.3.2 and Table S6.

Measurement of resilience (dependent variable)

In keeping with current conceptualizations of resilience,[11,12,15] we define resilience as

an outcome of good mental health despite exposure to adversity. We measure outcome-based resilience by relating self-reported changes in mental health problems P over the past two weeks (internalizing symptoms assessed with the General Health Questionnaire GHQ-12)[16] to the self-reported stressor exposure E during the same time window.[14] The E-P regression curve can be considered the normative predicted reactivity of mental health to stressor exposure in the sample. An individual's P score lying above the curve then expresses relative over-reactivity, a score lying below the curve relative under-reactivity. Following *17* and *18*, we therefore used individuals' inverse residuals onto the regression curve as a measure of their resilience RES.[19] This normative modeling method has the advantage that it inherently corrects for individual differences in stressor exposure (see also Suppl. 2.3.4). We differentiate between resilience to all stressors combined (RES_C), to general stressors (RES_G), and to Corona crisis-specific stressors (RES_S).

Statistical analyses

We first assessed the influence of the socio-demographic and health covariates on RES using separate univariate regression analyses and included all covariates surviving a likelihood ratio test at $p<0.2$ in all further analyses (Table S3). The directed hypotheses about resilience factors (above and Table S5) were tested separately using multiple regressions. The two planned mediation analyses (Table S5) were conducted following a Baron and Kenny approach. Significance was determined with the distribution-of-the-product method.[20] The alpha level for all analyses was $p<0.01$, two-tailed. The analyses were repeated for the subsample that had been interrogated about potential mental health conditions, adding past or present diagnosis as covariate. All results remained. There were no interactions between the additional covariate and the independent variables (data not shown). In the full sample, we also considered partial correlations of independent variables (Table S7). In order to identify the strongest resilience factors among the independent variables, we combined the variables and the included covariates in a LASSO analysis, where the L_1-Norm of the coefficients was penalized with a parameter λ.[21] The LASSO is used specifically as a sensitivity analysis for selecting important variables in multi-variable settings. We picked λ based on cross-validation to identify a subset of variables that is particularly suited for predicting resilience.

Results

The most frequently experienced general stressors (E_G) were negative political events (reported by 81% of participants), followed by burdensome experiences at work/school/university or another occupation (61%) and conflicts/disagreements in family, social, or professional settings (59%). The general stressors experienced as most burdensome were death of a loved one (average severity rating 3.97, possible answer range 1-5), followed by separation from a loved one (3.59) and oneself or a close person experiencing mental health problems (3.26). The most frequently experienced Corona crisis-specific stressors (E_S) were Corona-related media coverage (93%), closely followed by not being able to perform leisure activities (91%), loss of social contact (89%) and (feeling) restricted to leave home (87%). Most burdensome were the inability to attend a funeral of a family member/friend/loved one (3.84), family/friends/loved ones being at hospital while one is restricted to visit them (3.74), and family/friends/loved ones being at increased risk for a serious course of the disease in case of an infection (3.52). See Table S6 for details.

Because the general stressor list contained items that might be exacerbated by the Corona crisis (such as negative political events or family conflicts), answers to this list might also be influenced by the crisis. In another sample providing detailed general stressor reports before the crisis, we have observed a qualitatively different pattern of experienced stressors (Suppl. 2.3.2). In the current sample, we further found a high correlation between the general and the Corona crisis-specific stressor exposure scores E_G and E_S, respectively (R=0.62). Together, this indicates that the Corona crisis was the dominant source of stressors in the current sample. Because the combined stressor exposure score E_C also explained most variance in mental health problems P (see Methods), we focus on resilience to all stressors combined (RES_C).

An effect of the crisis on participants' mental health was suggested by high average P scores of 14.9±5.7 (s.d.) (possible range 0-36; comp. 9.7±4.9[22] and 8.3[23] in available representative samples from Europe). Participants with a past or present mental health condition had a higher average score (16.7±6.4) than those without (14.4±5.4; t=5.5, p<0.001).

Our primary hypothesis is that RES_C is positively associated with positive appraisal style (PAS). Controlling for covariates, PAS explained significant additional variance in RES_C (adjusted R^2 increase: 0.05, p<0.001). See Figure 1A and Tables S8-S10.

In agreement with the multifactorial nature of resilience,[11–13] all our key secondary hypotheses about resilience factors (see Methods) were also confirmed (all p<0.001, comp. Bonferroni threshold for multiple comparisons: p=0.01/9=0.0011; Fig. 1A; Tables S8-S10). Expectedly,[24] neuroticism had a strong negative influence.

We also predicted that the expected positive association of perceived social support with RES_C is positively mediated by its association with PAS and that the expected positive association of PAS with RES_C is positively mediated by its association with perceived good stress response recovery (see Suppl. 2.2.3). These hypotheses were also confirmed (Fig. 1B).

Noticeable intercorrelations between resilience factors were observed for the theoretically related constructs PAS, optimism, general self-efficacy, good stress response recovery, and (negatively) neuroticism (Table S7; Suppl. 2.2.2). PAS further showed a positive relationship with positive appraisal specifically of the Corona crisis (PAC). In a context of several interrelated resilience factors, the above separate multiple

regression analyses are not informative about the relative strengths of these factors in explaining resilience. In order to determine the statistically most influential factors, we combined all variables and covariates in a regularized regression analysis (LASSO)[21] on RES_C. This highlighted the role of PAC, followed by good stress response recovery, and (negatively) neuroticism (Fig. 2).

Discussion

We identify a positive association between resilience, defined as the outcome of maintained good mental health during a two-weeks period of stressor exposure in the European Corona lockdown, and positive appraisal style (PAS). This finding confirms and extends yet unpublished findings from our longitudinal studies that are being conducted in populations of healthy adults confronted with general stressors of everyday life, but not with situations comparable to the Corona crisis (Suppl. 2.2.2). We also identify positive associations between other hypothesized resilience factors and resilience. Because our hypotheses are nearly exclusively derived from analyses of populations confronted with stressors other than a pandemic, this indicates that many of the resilience factors described so far (e.g., *11–13*) may be 'global',[14] i.e., protective in different types of adverse circumstances. This result was not expected on theoretical grounds[14] but raises hopes that existing techniques for enhancing known resilience factors (e.g., *25,26*) may also be effective in the current crisis. Our results also indicate that the identified resilience factors are valid not only for healthy, but also for vulnerable populations with past or present psychiatric diagnoses.

In a comparative analysis of resilience factors (LASSO; Figure 2), we identify positive appraisal specifically of the Corona crisis (PAC) as the most important factor. PAC outperformed PAS as well as the related constructs optimism and general self-efficacy (Suppl. 2.2.2). Our PAC instrument asks participants about their current estimates of the consequences of the crisis for themselves and for society. This suggests that measuring the appraisal of the dominant stressors in a given situation has even better potential to explain their resilience than measuring a general appraisal style (PAS).

A similarly strong resilience factor was good stress response recovery. The recovery instrument used in our survey questionnaire[27] asks questions about typical, trait-like stress reactions, while our mental health instrument used to calculate RES[16] asks questions about current, symptom-like stress reactions. The semantic closeness of the instruments may explain the strong statistical relationship between recovery and RES_C and places the recovery construct somewhere between predictor and outcome variable.

This is interesting in the context of positive appraisal style theory of resilience (PASTOR).[14] PASTOR claims that the common final pathway to maintained mental health in the face of adversity lies in the tendency to appraise potential stressors with, a.o., an optimistic perspective on the probability of bad outcomes of the threatening situation and under the assumption of a high coping potential in case of a bad outcome (including high self-efficacy expectations; hence, the observed relationships with optimism and self-efficacy in Table S7). At the same time, positive appraisal in the sense of PASTOR avoids extremely unrealistically positive (delusional) appraisal tendencies that might give rise to trivialization or blind optimism. Positive appraisal effectively fine-tunes stress responses to optimal levels, that is, it produces stress reactions when necessary but also avoids unnecessarily strong, prolonged or repeated stress reactions. This prevents inefficient deployment of resources and concomitant deleterious allostatic load effects and reduces the likelihood of developing stress-related mental problems.[14]

The notion that positive appraisal permits optimal stress responding leads to the hypothesis that individuals showing high PAS scores have stress responses that are not higher and especially not longer than necessary (i.e., good stress response recovery). It is through this pathway that PAS eventually results in maintained mental health despite stressor exposure (i.e., resilience).[14] Our finding that perceived good stress response

recovery statistically mediates the relationship of PAS with resilience is in agreement with this hypothesis and may be another explanation for the close statistical relationship between recovery and resilience.

A further aspect of PASTOR is worth noting. By positing that PAS is the common final pathway to mental health (mediated by optimal stress responding), PASTOR also posits that the effects of other, especially non-cognitive resilience factors, are mediated by their way they shape PAS. That is, other resilience factors are more distal to the outcome of resilience relative to the proximal factor PAS. An explicit example given in *14* is the expected mediation of the effect of perceived social support on resilience by PAS, based on the assumption that believing that one can rely on others will make potential stressors be perceived as generally less threatening. Our results also agree with this second mediation hypothesis and therefore yield initial support for the theory.

Our findings identify psychological constructs that are promising targets of measures to protect mental health during the current crisis. PAS/PAS may be of specific interest both because of their proximal position relative to the resilient outcome and because positive appraisal tendency is specifically conceived as a malleable individual property that has some stability (hence, 'style') but can also be changed by experience and training.[14] Further, a key element in cognitive behavioral therapy and related evidence-based psychotherapy techniques is to change maladaptive threat appraisals.[28] This suggests an effective approach in the current crisis may be to change potentially unhelpful appraisal patterns towards a more productive attitude. This can be achieved through individual remote counseling or therapy, including via hotlines, (internet-based) provision of self-help materials and courses, suitable computer or smartphone apps, care in individual and public communication, and the generation of appropriate media content (e.g., *29–33*, adaa.org/finding-help/coronavirus-anxiety-helpful-resources). An appraisal-focused approach does not preclude approaches targeting other resilience factors, such as social support.[25,33]

A limitation of our study is that we are unable here to provide longitudinal data, which are considered the gold standard in resilience research.[11] By contrast, in our study, changes in mental health over the past two weeks are assessed retrospectively and therefore potentially affected by memory biases. Further, the associations we report are based on assessments conducted at the same time point, rather than being longitudinal, which may lead to overestimation of effects.[34] Therefore, our results will have to be confirmed by an ongoing longitudinal study with the same questionnaire (bit.ly/DynaCORE), which will, however, only yield final results in approximately 2.5 months. Another limitation is that our sample is self-selected and may thus not be representative (see also Table S1). Our conclusions are therefore of mechanistic nature – we identify effective resilience factors, but we cannot claim that they are effective in the general population or in specific subgroups of the population. Representativeness analyses as well as subgroup analyses that compare different subsamples (e.g., based on country of residence, socio-economic status, occupation, gender etc.) will only be feasible in a larger sample and are planned with increasing participant numbers. Such information will be highly valuable to individually target mental health protection measures.

To conclude, a resilience-focused approach to the psychological consequences of the Corona pandemic identifies protective factors that can be leveraged in efforts to prevent likely negative mental health consequences of the current crisis.

Contribution to data analysis

IMV, MZ, HE, LP, GK, SB, JW, HB, KSLY, HW, and RK cleaned and analyzed the data.

Open Science

For preregistration, see osf.io/r6btn. Data cleaning and analysis was performed in R (v3.6.3, www.r-project.org/). Data and scripts are available at osf.io/5xq9p/.

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References

1. Reissman DB, Watson PJ, Klomp RW, Tanielian TL, Prior SD. Pandemic Influenza Preparedness: Adaptive Responses to an Evolving Challenge. J Homeland Sec Emerg Manag 2006;3(2).
2. Pfefferbaum B, Schonfeld D, Flynn BW, et al. The H1N1 crisis: a case study of the integration of mental and behavioral health in public health crises. Disaster Med Public Health Prep 2012;6(1):67–71.
3. Lee AM, Wong JGWS, McAlonan GM, et al. Stress and psychological distress among SARS survivors 1 year after the outbreak. Can J Psychiatry 2007;52(4):233–40.
4. Brooks SK, Webster RK, Smith LE, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet 2020;395(10227):912–20.
5. Kang L, Ma S, Chen M, et al. Impact on mental health and perceptions of psychological care among medical and nursing staff in Wuhan during the 2019 novel coronavirus disease outbreak: A cross-sectional study. Brain Behav Immun 2020; doi: 10.1016/j.bbi.2020.03.028.
6. Lai J, Ma S, Wang Y, et al. Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019. JAMA Netw Open 2020;3(3):e203976.
7. Qiu J, Shen B, Zhao M, Wang Z, Xie B, Xu Y. A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. Gen Psychiatr 2020;33(2):e100213.
8. Wang C, Pan R, Wan X, et al. Immediate Psychological Responses and Associated Factors during the Initial Stage of the 2019 Coronavirus Disease (COVID-19) Epidemic among the General Population in China. Int J Environ Res Public Health 2020;17(5).
9. John N, Casey S, Carino G, McGovern T. Lessons Never Learned: Crisis and gender-based violence. Developing World Bioeth 2020. doi: 10.1111/dewb.12261.
10. Xiang Y-T, Yang Y, Li W, et al. Timely mental health care for the 2019 novel coronavirus outbreak is urgently needed. The Lancet Psychiatry 2020;7(3):228–9.
11. Kalisch R, Baker DG, Basten U, et al. The resilience framework as a strategy to combat stress-related disorders. Nat Hum Behav 2017;1(11):784.
12. Bonanno GA, Romero SA, Klein SI. The Temporal Elements of Psychological Resilience: An Integrative Framework for the Study of Individuals, Families, and Communities. Psychol Inq 2015;26(2):139–69.
13. Fritz J, de Graaff AM, Caisley H, van Harmelen A-L, Wilkinson PO. A Systematic Review of Amenable Resilience Factors That Moderate and/or Mediate the Relationship Between Childhood Adversity and Mental Health in Young People. Front Psychiatry 2018;9:230.
14. Kalisch R, Müller MB, Tüscher O. A conceptual framework for the neurobiological study of resilience. Behav Brain Sci 2015;38:e92.
15. Mancini AD, Bonanno GA. Predictors and Parameters of Resilience to Loss: Toward an Individual Differences Model. J Pers 2009;77(6):1805–1832.
16. Goldberg DP, Gater R, Sartorius N, et al. The validity of two versions of the GHQ in the WHO study of mental illness in general health care. Psychol Med 1997;27(1):191–7.
17. Amstadter AB, Myers JM, Kendler KS. Psychiatric resilience: longitudinal twin study. Br J Psychiatry 2014;205(4):275–80.
18. van Harmelen A-L, Kievit RA, Ioannidis K, et al. Adolescent friendships predict

later resilient functioning across psychosocial domains in a healthy community cohort. Psychol Med 2017;47(13):2312–22.

19. Kalisch R, Köber G, Binder H, et al. A generic solution for the operationalization and measurement of resilience and resilience processes in longitudinal observations: rationale and basic design of the MARP and LORA studies. PsyArXiv 2020; doi: 10.31234/osf.io/jg238.

20. Tofighi D, MacKinnon DP. RMediation: an R package for mediation analysis confidence intervals. Behav Res Methods 2011;43(3):692–700.

21. Hastie T, Tibshirani R, Wainwright M. Statistical Learning with Sparsity: The Lasso and Generalizations. Chapman & Hall/CRC Press, 2015.

22. Romppel M, Hinz A, Finck C, Young J, Brähler E, Glaesmer H. Cross-cultural measurement invariance of the General Health Questionnaire-12 in a German and a Colombian population sample. Int J Methods Psychiatr Res 2017;26(4).

23. Rodrigo MF, Molina JG, Losilla J-M, Vives J, Tomás JM. Method effects associated with negatively and positively worded items on the 12-item General Health Questionnaire (GHQ-12): results from a cross-sectional survey with a representative sample of Catalonian workers. BMJ Open 2019;9(11).

24. Jeronimus BF, Kotov R, Riese H, Ormel J. Neuroticism's prospective association with mental disorders halves after adjustment for baseline symptoms and psychiatric history, but the adjusted association hardly decays with time: a meta-analysis on 59 longitudinal/prospective studies with 443 313 participants. Psychol Med 2016;46(14):2883–906.

25. Ungar M. What Works - A Manual for Designing Programs that Build Resilience. Dalhousie, Canada: Resilience Research Center, 2019.

26. Joyce S, Shand F, Tighe J, Laurent SJ, Bryant RA, Harvey SB. Road to resilience: a systematic review and meta-analysis of resilience training programmes and interventions. BMJ Open 2018;8(6):e017858.

27. Smith BW, Dalen J, Wiggins K, Tooley E, Christopher P, Bernard J. The brief resilience scale: assessing the ability to bounce back. Int J Behav Med 2008;15(3):194–200.

28. Alford BA, Beck AT. The Integrative Power of Cognitive Therapy. Guilford Press, 1997.

29. Heber E, Ebert DD, Lehr D, et al. The Benefit of Web- and Computer-Based Interventions for Stress: A Systematic Review and Meta-Analysis. J Med Internet Res 2017;19(2):e32.

30. Li W, Yang Y, Liu Z-H, et al. Progression of Mental Health Services during the COVID-19 Outbreak in China. Int J Biol Sci 2020;16(10):1732–8.

31. Joyce S, Shand F, Lal TJ, Mott B, Bryant RA, Harvey SB. Resilience@Work Mindfulness Program: Results From a Cluster Randomized Controlled Trial With First Responders. J Med Internet Res 2019;21(2):e12894.

32. Kazlauskas E, Eimontas J, Olff M, Zelviene P, Andersson G. Adherence Predictors in Internet-Delivered Self-Help Intervention for Life Stressors-Related Adjustment Disorder. Front Psychiatry 2020;11:137.

33. van Buschbach S, van der Meer CAI, Dijkman L, Olff M, Bakker A. Web-Based Peer Support Education Program for Health Care Professionals. Jt Comm J Qual Patient Saf 2020;46(4):227–31.

34. Allison PD. Fixed Effects Regression Models [Internet]. Thousand Oaks, CA, USA: SAGE Publications, 2009.
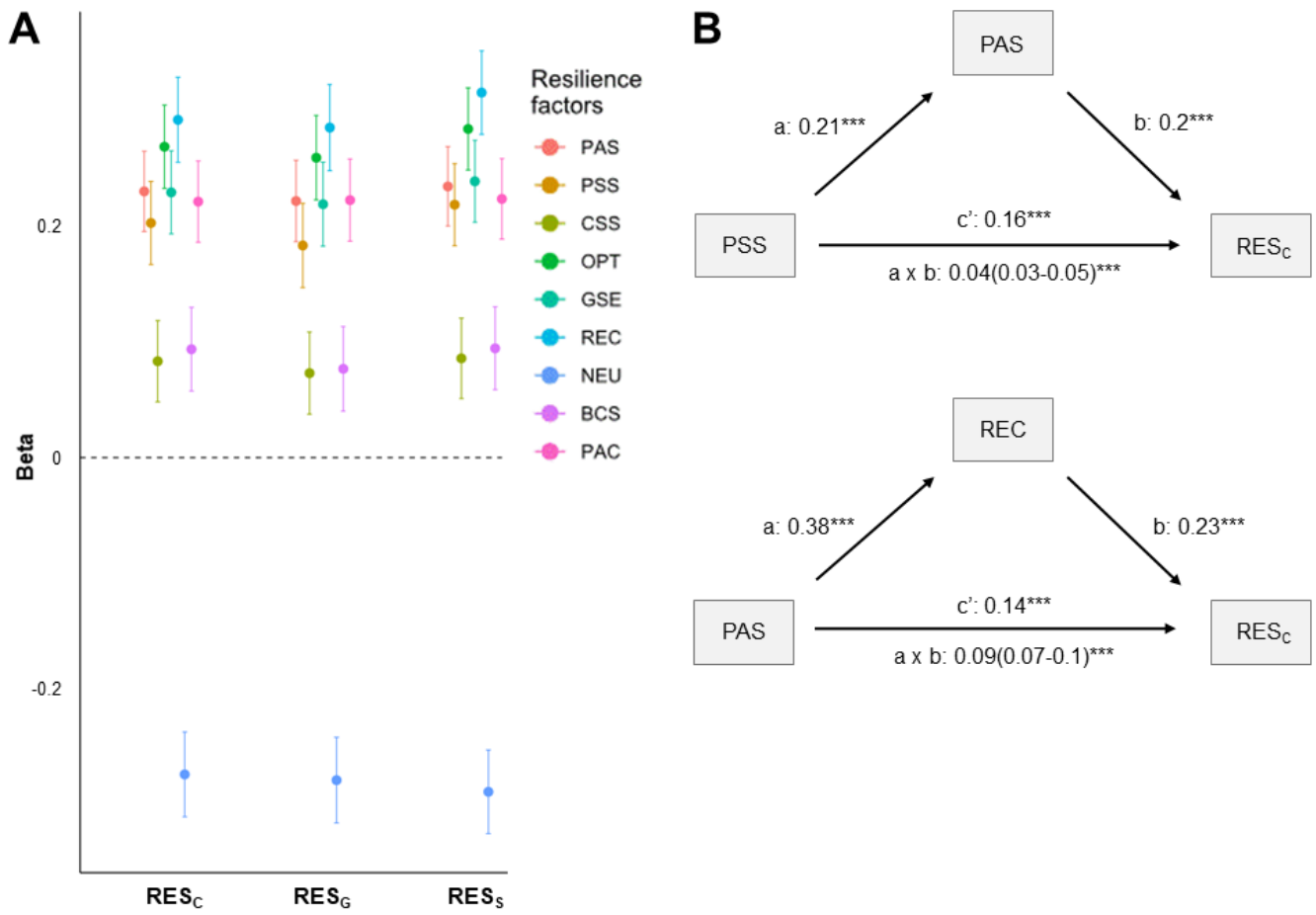
Figure 1. Associations of hypothesized resilience factors with outcome-based resilience (RES) and mediation effects. A) Multiple regressions with covariates of resilience factors on resilience, calculated separately for each factor. Shown are the regression coefficients (betas) and 99% confidence intervals (CI). Effects are similar for resilience to all stressors combined (RES_C), resilience to general (RES_G) and resilience to Corona-specific stressors (RES_S). Resilience factors: PAS, positive appraisal style; PSS, perceived social support; CSS, perceived increase in social support during the Corona crisis; OPT, optimism; GSE, perceived general self-efficacy; REC, perceived good stress recovery; NEU, neuroticism; BCS, behavioral coping style; PAC, positive appraisal specifically of the Corona crisis. B) Mediation analyses testing if the positive association of PSS with RES_C is mediated by PAS (top) and if the positive association of PAS on RES_C is mediated by REC (bottom). Shown are betas of all paths. Indirect path a x b: beta with 99% CI. ***$p < 0.001$.
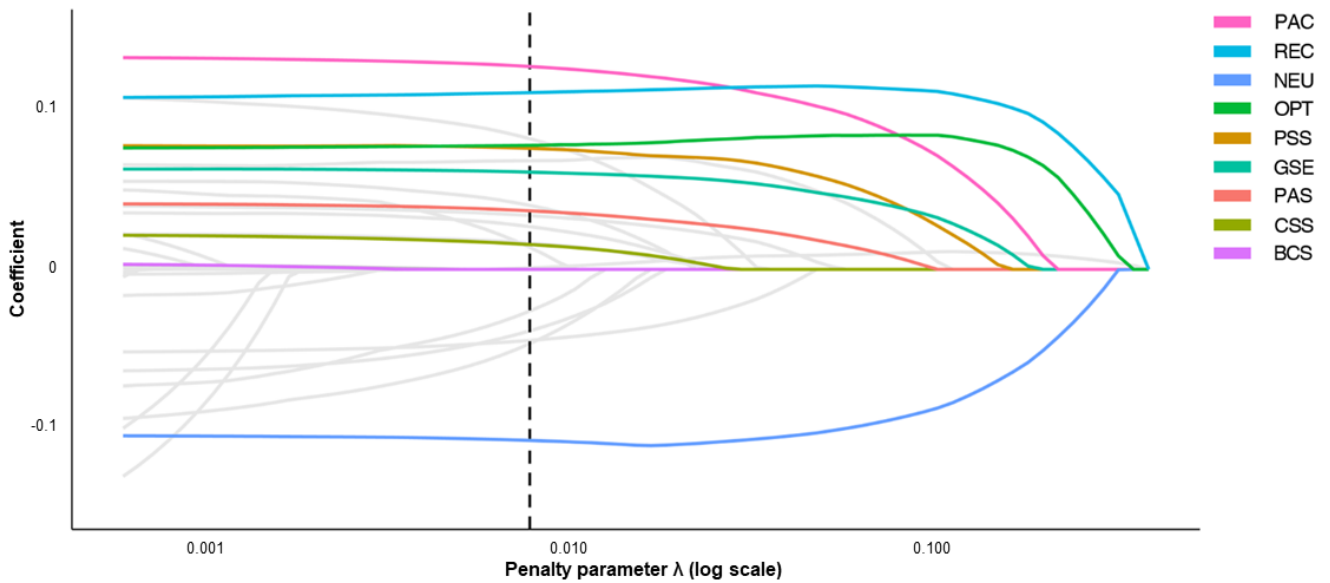
Figure 2. Combined multi-variable analysis (LASSO) of the relative associations of resilience factors and covariates with resilience (RES_C). In order to identify the strongest of the partly correlated resilience factors, sparse regression was performed with an optimal penalty term λ (vertical broken line), as determined by cross-validation. Resilience factors are indicated in color, covariates in grey. The initial position of a curve on the y-axis signifies the association of the corresponding resilience factor or covariate with RES_C in the case of very low penalization. By increasing λ (x-axis), regression coefficients get increasingly drawn to zero, to leave only the strongest associations. The order of resilience factors in the color legend corresponds to their determined relative strengths (absolute values) at optimal λ (broken line). Except for BCS, all resilience factors were selected in all 800 repeated LASSO runs, indicating strong replication stability.