**Dynamic Relations Among COVID-19-Related Media Exposure and Worries
During the COVID-19 Pandemic**

Andrea Schmidt^{1,2}, Annette Brose³, Andrea C. Kramer^{1,2}, Florian Schmiedek^{1,2,4},

Michael Witthöft⁵, & Andreas B. Neubauer^{1,2}

¹ DIPF | Leibniz Institute for Research and Information in Education, Frankfurt am
Main, Germany

² Center for Research on Individual Development and Adaptive Education of Children
at Risk (IDeA), Frankfurt am Main, Germany

³ Humboldt University, Berlin., Germany

⁴ Goethe-University, Frankfurt am Main, Germany

⁵ Johannes Gutenberg University, Mainz, Germany

Correspondence concerning this article should be addressed to Andrea Schmidt,
DIPF | Leibniz Institute for Research and Information in Education, and Center for Research
on Individual Development and Adaptive Education of Children at Risk (IDeA), Rostocker
Straße 6, 60323 Frankfurt a. M., Germany. E-mail: andrea.schmidt@dipf.de

We would like to thank Michaela Menstell for her valuable support in realizing the
PACO project.

Data availability statement:

The data that support the findings of this study are openly available in the OSF at:
https://osf.io/gbw5t/?view_only=a04a4e5615b44ce8b9a37b496499dd2e.

Abstract

Objectives: This study investigated how COVID-19-related media exposure during the COVID-19 crisis was related to same-day and next-day COVID-19-related worries.

Design: A 21-day diary study was conducted between late March and late April 2020 in Germany.

Main Outcome Measures: Hypotheses were tested in a sample of 561 participants ($M_{\text{age}} = 42.79$, $SD_{\text{age}} = 6.12$). Every evening, participants indicated their exposure to COVID-19-related media (e.g., TV, print, online) and their COVID-19-related worries.

Results: Same-day analyses showed that participants reported more COVID-19-related worries on days with higher exposure to COVID-19-related media. Dynamical structural equation models provided evidence for a reciprocal cycle across days: Higher media exposure at one day predicted higher worries the next day, and higher worries at one day also predicted higher media exposure the next day. Individuals with high trait anxiety reported an enhanced general level of media exposure during the 21 days of assessment, and individuals high in neuroticism and anxiety reported an enhanced level of worries.

Conclusion: These findings suggest a self-reinforcing cycle whereby consuming crisis-related media and worrying reciprocally influence each other across days, possibly amplifying adverse effects of the COVID-19 crisis and other crises alike on mental and physical health.

Keywords: COVID-19, media exposure, well-being; ambulatory assessment, dynamic structural equation modeling

Dynamic Relations Among COVID-19-Related Media Exposure and Worries During the COVID-19 Pandemic

Recent research on the initial stage of the coronavirus outbreak reported high prevalence rates of depressive symptoms, anxiety symptoms, and stress levels (Wang et al., 2020). As worries (and negative repetitive thoughts more generally; Wahl et al., 2019) are among the everyday precursors of mental disorders (Papageorgiou, 2006; Purdon & Harrington, 2006; Wahl et al., 2019), shedding light on the processes that might exacerbate or attenuate the worry process in people's daily lives is paramount, though lacking in the literature so far. A recent review (Garvin et al., 2020) emphasizes the role of crisis-related media exposure in amplifying public health consequences of the COVID-19 crisis: Based on research on previous health crises and collective traumata, repeated media consumption has been shown to potentially lead to poor health. However, an examination of the short-term dynamics among media exposure and worries during a large-scale health crisis that involves various restrictions to people's regular lifestyles as well as a rapid dissemination of up-to-date information on the evolving situation worldwide, is lacking. Addressing this gap, the present work investigated the likely reciprocal within-person links between worries and media exposure at the same day and from one day to the next during the COVID-19 crisis in Germany to understand an important process during this and other crises alike. Understanding the dynamics of media exposure and worries about the pandemic is important to alleviate the potentially negative downstream effects of the pandemic on mental and physical health.

By definition, worries represent "an attempt to engage in mental problem-solving on an issue whose outcome is uncertain but contains the possibility of one or more negative outcomes" (Borkovec et al., 1983, p. 10). During crises as the COVID-19 pandemic, people commonly worry about their health, future employment, and the impact of the pandemic on

family and friends (Jungmann & Witthöft, 2020; Kleinberg et al., 2020; Wang et al., 2020). Although worrying can sometimes aid in identifying ways to avoid or prepare for negative events (Sibrava & Borkovec, 2006), it is typically perceived as aversive. Besides, worries have been shown to be associated with poor physical health such as an increased heart rate (Pieper et al., 2010), an elevated risk for coronary heart disease (Kubzansky et al., 1997), and reductions in heart rate variability (Brosschot et al., 2007; Chalmers et al., 2016; see also Tully et al., 2013; Ottaviani et al., 2016, for a review and meta-analysis). Further studies found worrying to be linked to somatic complaints (Brosschot & van den Doef, 2007; see Brosschot et al., 2006, for a review) and a dysregulation of the autonomic nervous system (Borkovec & Hu, 1990).

During times of uncertainty, people also commonly consume media to feel better informed. Ubiquitous Internet access provides the opportunity to search for respective information at any point in time and smartphone applications allow people to get the latest news via automated notifications right on screen. Thus, the Internet enables rapid dissemination of current best practices and policy recommendations during crisis events (Chan et al., 2020). The importance of valid and regular official information has been demonstrated in prior crises, as people experienced higher distress during periods without crisis updates from official channels (Jones et al., 2017). Recent evidence further suggests that feeling informed about the COVID-19 pandemic is related to lower (virus) anxiety, stress, depression, and, presumably, lower worries (Jungmann & Witthöft, 2020; Wang et al., 2020).

However, ubiquitous access to information, especially if sensational, frightening, or ambiguous, can elicit worries. As such, experimental research has shown that sensational television reports produce an increase in health worries (Witthöft et al., 2018). Furthermore, the permanent opportunity to inform oneself can lead to preoccupation with the crisis, leaving

little room for adaptive disengagement and positive distraction (Waugh et al., 2020). For instance, event-related media exposure was cross-sectionally associated with event-related worry and psychological distress during the Ebola crisis 2014 (Thompson et al., 2017). Additionally, there is evidence suggesting a cyclical link between media exposure and worries: In a 3-year longitudinal study, Thompson et al. (2019) found that media exposure to a mass violence event (i.e., the 2013 Boston marathon bombings) predicted distress, which in turn longitudinally predicted worry about future negative events. Furthermore, these worries predicted heightened media exposure and distress after the 2016 Pulse nightclub massacre (Thompson et al., 2019).

The Present Study

Together, media exposure and worries are commonly enhanced during crises such as the COVID-19 pandemic. Theoretical considerations and first empirical research suggest reciprocal relations among these variables. However, within-person research targeting the processes that might exacerbate or attenuate the worry process in people's daily lives or that may help understanding the effects of continuous media consumption is still lacking. That is, crises probably come with processes like mental ups and down, including peaks of worries, and these occur within individuals across time. Research is needed, and yet missing, that sheds light on these processes and tackles mutual influences that might also vary across time, like continuous media consumption.

Addressing this gap, we investigated the daily associations between COVID-19-related media exposure and COVID-19-related worries, hypothesizing a cyclical within-person link across days. Given that short-term processes occurring within individuals may determine individuals' longer-term development towards either long-term mental health or psychopathology (Wichers, 2014), as well as physical health outcomes such as sleep (Ong et al., 2013) and even mortality (Mroczek et al., 2015), illuminating the day-to-day within-

person processes between media exposure and worries is paramount: Insights on such dynamics may contribute to attenuating the negative impact of the COVID-19 pandemic and other crises on mental and physical health because they might reveal a potential mechanism related to decline in health (Wang et al., 2020).

In an exploratory fashion, this study also examined whether the strength of the associations between worries and media exposure as occurring within individuals varies across people. Specifically, this study tested the expectation that people who experienced high trait anxiety show stronger links between daily COVID-19-related media exposure and daily worries (as suggested by Thompson et al., 2017). Furthermore, we followed recent research demonstrating that individuals high in neuroticism pay more attention to and worry more about COVID-19-related information (Kroencke et al., 2020) and examined neuroticism as another potential vulnerability factor exacerbating the relation between media exposure and worries during the pandemic.

Method

In the following, the measures relevant for the current work are presented. A more detailed description of the study and the assessed constructs, as well as all data and analysis code necessary to reproduce the main results reported here can be found in the Open Science Framework (<https://osf.io/gbw5t/>). The data presented in the current work was collected as part of the [*blinded*] study, whose central purpose it was to investigate the adjustment of parents of schoolchildren to the COVID-19 pandemic. Therefore, only individuals who indicated to live in the same household with (at least) one school-aged child could participate in this study. Study participation was voluntary and could be terminated at any time. The study was approved of by the local Ethics committee.

Procedure

The study consisted of a baseline assessment, a 21-day diary period, and a post assessment. All assessments were implemented as online questionnaires on [soscisurvey.de](https://www.soscisurvey.de). In the baseline assessment, participants provided informed consent and responded to sociodemographic and trait questionnaires. Participants could enroll into the subsequent diary part consisting of a 21-day period during which participants received online questionnaires every evening. Completion of the questionnaire took about 5-7 minutes. The first participant started the daily diary study at March 28th 2020, while the last participant finished it at April 27th 2020.

Participants

A convenience sample of $N = 970$ participants (838 women) between 25 and 82 years of age ($M = 42.93$, $SD = 6.40$) took part in the baseline questionnaire until at least all sociodemographic variables were assessed. The present work uses a subsample of $N = 561$ participants (489 women, $M_{\text{age}} = 42.79$, $SD_{\text{age}} = 6.12$, range = 25-63) who subscribed for the diary part and provided data on at least one day¹. Overall, data of 7,734 daily assessments were available (compliance rate: 65.6%).

The majority of participants was married (68.1%) or in a permanent relationship (13.9%), while 5.0% were single, 11.4% were separated/divorced, and 1.6% were widowed. In early March 2020 (before COVID-19-related restrictions were introduced), 35.5% were full-time employed, 50.1% were part-time employed, 1.6% were unemployed, 7.3% indicated to be housewife/househusband, and 5.5% reported a different employment status. The monthly net household income was > 4000€ for 40.6%; between 3000€ and 4000€ for 20.5%, and < 3,000€ for 31% (7.3% preferred to not answer this question).

¹ Originally, 562 participants subscribed for the diary part; however, one participant was excluded, as due to a technical error, his or her daily data could not be matched to his or her baseline data.

Measures

Daily Measures

COVID-19-Related Media Exposure. Every evening, participants' media exposure to information concerning the COVID-19-pandemic was assessed. Specifically, they were asked "How often did you update yourself about the corona pandemic today (e.g., by reading newspapers, watching the news, push notifications, online news)?" and "How often did you check up on posts, articles, images, comments regarding the corona pandemic on social media today?". Both items were answered on a 5-point scale with response options 1 = "*not at all*", 2 = "*rarely*", 3 = "*sometimes*", 4 = "*often*", and 5 = "*very often*" and averaged per participant and day.

COVID-19-Related Worries. COVID-19-related worries were assessed using two items ("I spent a lot of time thinking about the Corona pandemic today"; "Today, I worried about the Corona pandemic and its effects on myself and my family") that were answered on a 7-point scale (with endpoints labeled 1 = "*completely disagree*" and 7 = "*completely agree*") and averaged per participant and day.

Baseline Measures

Neuroticism. The German Short Form of the Big Five Inventory (Rammstedt & John, 2005) was used. Neuroticism was calculated as the mean of four statements, for which participants rated the extent they applied to them in general on a 5-point scale (1 = "*not at all true*" to 4 = "*very true*"). Reliability was estimated as internal consistency (McDonald's ω) and was adequate ($\omega = .82$).

Anxiety. The German translation (Laux et al., 1981) of the State Anxiety Inventory (Spielberger et al., 1970) was used and instructions and item wordings were adjusted so that they referred to participants' experiences in the last week. Participants indicated the extent to

which they experienced each of the affective states on a 4-point scale (1 = “*not at all*” to 4 = “*very*”). Responses to the 20 items were averaged per participant ($\omega = .95$).

Plan of Analyses

In *Step 1*, time-related trends in the variables of interest across the three weeks of daily assessments were descriptively explored. As these plots revealed non-linear trends in the variables, piecewise growth curve modeling (Cudeck & Harring, 2007) in R for Windows, version 3.5.1 (R Core Team, 2017) was used to account for the different periods of trends in the data. In *Step 2*, it was investigated how daily COVID-19-related media exposure was associated with same-day COVID-19-related worries. As the present data comprised a multilevel structure with repeated daily assessments (Level 1) nested within individuals (Level 2), multilevel structural equation models (multilevel SEM) were conducted in Mplus Version 8.3 (Muthén & Muthén, 1998-2017) using the Bayesian estimator. Day of the week (0 = weekday; 1 = weekend/holiday) was included as a predictor of COVID-19-related media exposure and worries on both levels to control for differences during the week versus days at the weekend/holidays. Neuroticism (Model 2), trait anxiety (Model 3), and both (Model 4) were added as between-person predictors to examine whether the within-person association between COVID-19-related media exposure and worries was moderated by these variables.

In *Step 3*, the mutually reciprocal across-day effects between COVID-19-related media exposure and worries were examined, employing dynamic SEM (DSEM; Asparouhov et al., 2017). Targeting within-person processes, tomorrow's worries were predicted by today's worries (autoregressive effect) and, essential to this study's aims, today's media exposure (cross-lagged effect). Furthermore, tomorrow's media exposure was predicted by today's media exposure (autoregressive effect) and today's worries (cross-lagged effect). As in the multilevel SEM, neuroticism and trait anxiety were entered as predictors and moderator variables, and day of the week was included as a covariate on both levels.

In all analyses within the Bayesian framework (Steps 2 and 3), parameters were considered to be statistically meaningful if their 95% credible interval did not include zero. A more detailed, technical description of the analyses and model specifications can be found in the Online Supplement S1.

Results

Descriptive statistics, reliabilities, and bivariate correlations of all measures are presented in Table 1.

Please insert Table 1 here.

Step 1. The visualization of trends of media exposure and worries across the three weeks of daily assessments revealed a peak on study day 18, which corresponded to April 15th 2020 (see Figure 1). On this day, the German government announced the extension of COVID-19-related restrictions. To examine the distinct phases of trends (i.e., before and after the announcement) in both variables in more detail, piecewise growth curve modeling was used (Cudeck & Harring, 2007). Variables reflecting the different periods were created: The variable *pre-event* counted study days prior to the event (i.e., before April 15th 2020), *event* was coded 0 for the time before the event and was coded 1 for the day of the event and the time following the event, and *post-event* counted study days following the event. Random slopes for these three predictors were added and covariances between the random slopes were estimated.

The analyses revealed that from the beginning of the study (March 28th 2020) until the day before the event (April 14th 2020), average media exposure decreased significantly ($b_{\text{pre-event}} = -0.04$, 95% confidence interval = $[-0.05, -0.03]$, $p < .001$; see Figure 1, Panel A). Average media exposure was predicted at 2.06 ($b_{\text{Intercept}} = 2.06[1.99, 2.13]$, $p < .001$) on the day before the event (April 14th 2020) and increased by 0.55 ($b_{\text{event}} = 0.55[0.48, 0.62]$, $p <$

.001) on the event day (April 15th 2020). After the event (from April 15th to April 27th 2020), average media exposure decreased significantly ($b_{\text{post-event}} = -0.08[-0.10, -0.07]$, $p < .001$).

From the beginning of the study until the day before the event, average worries decreased significantly ($b_{\text{pre-event}} = -0.03[-0.04, -0.02]$, $p < .001$; see Figure 1, Panel B). Average predicted worries were 3.35 ($b_{\text{Intercept}} = 3.35[3.21, 3.49]$, $p < .001$) on the day before the event and increased by 0.90 ($b_{\text{event}} = 0.90[0.76, 1.03]$, $p < .001$) on the event day. After the event, average worries decreased significantly ($b_{\text{post-event}} = -0.10[-0.12, -0.07]$, $p < .001$) until the end of the study.

For all further analyses, the variables COVID-19-related media exposure and worries were detrended to account for the different periods. The individual model-based residuals that remained after controlling for the fixed and random effects of the three predictors (pre-event, event, post-event) were used for all further analyses. For each person, the predicted individual average was added to the residual variable to account for the average level of media exposure and worries, respectively.

Please insert Figure 1 here.

Step 2. Figure 2 depicts the main findings of Model 4 (see Online Supplement, Table S2, for full results). As expected, COVID-19-related media exposure positively predicted COVID-19-related worries on a daily basis—above-average media exposure was associated with above-average worries. All models examining the same-day within-person associations between media exposure and worries converged successfully with a maximum probability of scale reduction (PSR) of 1.001. Visual inspection of the trace plots revealed successful mixing and no irregularities.

The analyses of potentially moderating effects of anxiety and neuroticism revealed that individuals with above-average levels of anxiety on average reported higher media exposure and more worries during the 21 days of assessment. Additionally, individuals with

higher neuroticism experienced more worries during the study. When not controlling for trait anxiety (Model 2), higher neuroticism was also associated with higher media exposure during the 21-day period. The cross-level interactions (not presented in Figure 2) were not statistically meaningful, indicating that the strength of the within-person association between media exposure and worries did not differ depending on individuals levels of neuroticism or trait anxiety (neuroticism: $b = 0.01$, 95% credible interval = $[-0.06, 0.09]$; trait anxiety: $b = 0.08[-0.04, 0.20]$). Furthermore, covariate analyses revealed that on weekends or holidays, both media exposure and worries were lower than on weekdays (media: $b = -0.10[-0.11, -0.08]$; worries: $b = -0.09[-0.12, -0.06]$).

Please insert Figure 2 here.

Step 3. Table 2 shows the results of DSEM analyses (see Online Supplement Table S3 for unstandardized results including variances of random effects). The two autoregressive effects were statistically meaningful, indicating that today's COVID-19-related media exposure (worries) predicted tomorrow's COVID-19-related media exposure (worries). Furthermore, the results suggested reciprocally reinforcing effects, in that days with higher media exposure were followed by an increase in worries on the next day, and days with higher worries were followed by days with increased media exposure. The DSEM examining reciprocal effects between media exposure and worries converged successfully with a maximum PSR of 1.004. Visual inspection of the trace plots revealed successful mixing and no irregularities.

Please insert Table 2 here.

Discussion

This study's central interest pertained to the reciprocal effects between media exposure and worries during the COVID-19 pandemic in Germany between end of March and end of April 2020. Examining day-to-day relations, we found that on days when

individuals reported higher exposure to crisis-related media, they thought and worried more about the crisis. This is in line with Thompson et al. (2017), who showed that event-related media exposure was cross-sectionally associated with event-related worry following the Ebola outbreak. However, our findings extend prior cross-sectional research by demonstrating that media exposure and worries are not only related on the level of between-person differences, but also on a daily level within individuals (Molenaar, 2004).

To disentangle the temporal direction of the interplay between COVID-19-related media exposure and worries as occurring within individuals across time, we also examined effects across days. Today's media exposure and worries positively predicted respective variables at the next day (i.e., there was a persistence in the levels of these variables across days). Furthermore, the analyses indicated mutually reinforcing effects across time: Worries were higher on days after which individuals reported higher exposure to COVID-19-related content. Likewise, individuals consumed more COVID-19-related media on days after which they experienced more worries. While these findings seem to indicate a negative process across time, in the sense that it seems difficult to get out of a negative state once in it, these findings also imply a more adaptive process across time, in that lower worries today predicted less media exposure tomorrow and less media exposure today predicted lower worries tomorrow. The present findings are consistent with Thompson et al. (2019), showing that individuals who were extensively exposed to media about collective traumas responded more strongly to this event as well as to future events "as a function of their ongoing worry" (p. 2). Yet, this study examined associations across several years and was limited to mass violence events. Our study goes beyond this research by demonstrating mutually reinforcing within-person effects of media exposure on subsequent worries and of worries on subsequent media exposure during a large-scale health crisis that affected people's daily lives around the globe.

This study also explored whether individuals with higher levels of neuroticism and trait anxiety showed stronger links between worry and media exposure. This was not the case. Yet, in accordance with recent evidence indicating that individuals high in neuroticism attended more to and worried more about COVID-19-related information (Kroencke et al., 2020), individuals high in neuroticism were found to experience more COVID-19-related worries during the 21 days of assessment. Similarly, our results showed that individuals high in trait anxiety reported higher levels of COVID-19-related media exposure and worries across the study, identifying anxiety as a potential risk factor for maladaptive behavioral and cognitive patterns. One possible explanation for why links between daily media exposure and worries were not intensified in individuals with high neuroticism or high trait anxiety might be that exacerbated worries in these individuals stem from a rather stable disposition less sensitive to situational influences.

Furthermore, our analyses revealed that COVID-19-related media exposure and worries decreased across time unless some meaningful external event disrupted this decline. Thus, both showed a peak on the day the German government announced further COVID-19-related procedures such as the extension of social contact restrictions and the strong recommendation of wearing face masks in the public. Although our findings suggest an initial “shock” at this day, they also indicate a recovery effect across the following days (i.e., declines in both variables).

To attenuate the adverse psychological and physical impacts of the COVID-19 pandemic (e.g., Wang et al., 2020) and other large-scale health crises, it is essential to develop prevention and intervention measures. The current work suggests two concrete starting points for such programs: decreasing either crisis-related worries or crisis-related media exposure. Worries might be attenuated via mindfulness which builds on the transience of all things and might help individuals to remind themselves that the COVID-19-related

restrictions will also be eased some day (Polizzi et al., 2020). Progressive muscle relaxation which aims at relaxing the body might also help to shut off mental activity such as worrying (e.g., Ferguson, 2003; Sánchez-Meca et al., 2010). COVID-19-related media consumption could be reduced by positive distraction (e.g., pursuing leisure activities that are still possible besides potential COVID-19-related restrictions; see e.g., Waugh et al., 2020). It might be promising to alter individual's media consumption and worries in non-crisis times as well, as it is likely that the within-person processes among them also contribute to the development of mental disorders and physical illness during regular times, especially among high-risk populations.

Limitations

Having sampled data from a convenience sample of parents in Germany mainly consisting of women limits the generalizability of findings. Prior research has suggested that women's well-being might be affected more by (social) media use than men's well-being (e.g., Fioravanti et al., 2020). Furthermore, the sample seemed to be positively selected, as indicated by high education and high income. Such a sample might be affected less by the pandemic than low-income families, for instance, possibly leading to average levels of worries below the scale mean. More heterogeneous and representative samples are needed to establish the generalizability of the current findings.

Second, daily assessments of COVID-19-related media exposure and worries had to be kept short to minimize participant burden. Two items were certainly not comprehensive of the constructs and prevented the differentiation of different types of media sources (e.g., print media vs. online media). Furthermore, worries and media exposure were assessed on different response scales (worries: 7-point Likert scale assessing agreement to statements; media exposure: 5-point Likert scale assessing frequencies) which may have induced differential response behavior to these two scales. As print media might be more validated

than information posted in the Internet, for instance, further research should test whether differences in the source of information modulate the relation between crisis-related media exposure and worries (see Holman et al., 2020). Likewise, we could not quantify the exact amount of time spent with certain information and could not distinguish whether participants actively searched for news on the Internet or whether they consumed information more passively on TV. Future research should explore whether such differences might affect the associations between media exposure and worries.

Third, although time-lagged effects suggest causality in the current findings, it cannot be precluded that time-varying third variables with parallel trends might have affected both, media exposure and worries. To produce spurious lagged effects, however, such third variables would need to have a relatively immediate effect on one variable (e.g., worries) today and a delayed effect on the other variable (e.g., media exposure) on the next day, which may be an unlikely scenario.

Conclusion

With worries defined as a central everyday precursor of mental disorders (American Psychiatric Association, 2013; Purdon & Harrington, 2006), the current findings suggest that the daily amount people spend consuming COVID-19-related information might amplify adverse health effects of the crisis. As such, there might be a self-reinforcing spiral of media exposure and worries, potentially leading to poor mental and physical health. However, it is important to acknowledge that the cyclical relation among COVID-19-related media exposure and worries might also be interpreted in a more adaptive way, suggesting that individuals reported lower worries (media exposure) on days after which they consumed less crisis-related media (worries). Thus, the identified short-term dynamics across COVID-19-related media exposure and worries might, in the long run, either maintain health or give rise to illness and psychopathology (Wichers, 2014).

References

- American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC, London, England: Author.
- Asparouhov, T., Hamaker, E. L., & Muthén, B. (2017). Dynamic structural equation models. *Structural Equation Modeling: A Multidisciplinary Journal*, 25(3), 359–388.
<https://doi.org/10.1080/10705511.2017.1406803>
- Borkovec, T. D., Hu, S. (1990). The effect of worry on cardiovascular response to phobic imagery. *Behaviour Research and Therapy*, 28(1), 69-73. [https://doi.org/10.1016/0005-7967\(90\)90056-O](https://doi.org/10.1016/0005-7967(90)90056-O)
- Borkovec, T. D., Robinson, E., Pruzinsky, T., & DePree, J. A. (1983). Preliminary exploration of worry: Some characteristics and processes. *Behaviour Research and Therapy*, 21(1), 9–16. [https://doi.org/10.1016/0005-7967\(83\)90121-3](https://doi.org/10.1016/0005-7967(83)90121-3)
- Brosschot, J. F., Gerin, W., & Thayer, J. F. (2006). The perseverative cognition hypothesis: A review of worry, prolonged stress-related physiological activation, and health. *Journal of Psychosomatic Research*, 60(2), 113-124.
<https://doi.org/10.1016/j.jpsychores.2005.06.074>
- Brosschot, J. F., Van Dijk, E., Thayer, J. F. (2007). Daily worry is related to low heart rate variability during waking and the subsequent nocturnal sleep period. *International Journal of Psychophysiology*, 63(1), 39-47. <https://doi.org/10.1016/j.ijpsycho.2006.07.016>
- Brosschot, J. F. & van den Doef, M. (2007). Daily worrying and somatic health complaints: Testing the effectiveness of a simple worry reduction intervention. *Psychology & Health*, 21(1), 19-31. <https://doi.org/10.1080/14768320500105346>
- Chalmers, J. A., Heathers, J. A., Abbott, M. J., Kemp, A. H., & Quintana, D. S. (2016). Worry is associated with robust reductions in heart rate variability: A transdiagnostic

- study of anxiety psychopathology. *BMC Psychology*, 4(32), 1-9.
<https://doi.org/10.1186/s40359-016-0138-z>
- Chan, A. K. M., Nickson, C. P., Rudolph, J. W., Lee, A., & Joynt, G. M. (2020). Social media for rapid knowledge dissemination: Early experience from the COVID-19 pandemic. *Anaesthesia*. Advance online publication. <https://doi.org/10.1111/anae.15057>
- Cudeck, R., & Harring, J. R. (2007). Analysis of nonlinear patterns of change with random coefficient models. *Annual Review of Psychology*, 58(1), 615–637.
<https://doi.org/10.1146/annurev.psych.58.110405.085520>
- Ferguson, K. E. (2003). Relaxation. In W. O'Donohue, J. E. Fisher, & S. C. Hayes (Eds.), *Cognitive behavior therapy: Applying empirically supported techniques in your practice* (pp. 330–340). Hoboken, NJ: John Wiley & Sons Inc.
- Fioravanti, G., Probst, A., & Casale, S. (2020). Taking a short break from Instagram: The effects on subjective well-being. *Cyberpsychology, Behavior and Social Networking*, 23(2), 107–112. <https://doi.org/10.1089/cyber.2019.0400>
- Grawe, K. (2000). *Psychologische Therapie* (2nd ed.). Göttingen: Hogrefe.
- Holman, E. A., Garfin, D. R., Lubens, P., & Silver, R. C. (2020). Media exposure to collective trauma, mental health, and functioning: Does it matter what you see? *Clinical Psychological Science*, 8, 111–124. <http://dx.doi.org/10.1177/2167702619858300>
- Jones, N. M., Thompson, R. R., Dunkel Schetter, C., & Silver, R. C. (2017). Distress and rumor exposure on social media during a campus lockdown. *Proceedings of the National Academy of Sciences*, 114(44), 11663–11668. <https://doi.org/10.1073/pnas.1708518114>
- Jungmann, S. M., & Withöft, M. (2020). Health anxiety, cyberchondria, and coping in the current COVID-19 pandemic: Which factors are related to coronavirus anxiety? *Journal of Anxiety Disorders*, 102239. <https://doi.org/10.1016/j.janxdis.2020.102239>

- Kleinberg, B., van der Vegt, I., & Mozes, M. (2020). Measuring emotions in the COVID-19 real world worry dataset. Retrieved from <https://arxiv.org/pdf/2004.04225>
- Kroencke, L., Geukes, K., Utesch, T., Kuper, N., & Back, M. (2020, May 10). Neuroticism and emotional risk during the Covid-19 pandemic. Advance online publication. <https://doi.org/10.31234/osf.io/8c6nh>
- Kubzansky, L. D., Kawachi, I., Spiro, A., Weiss, S. T., Vokonas, P. S., Sparrow, D. (1997). Is worrying bad for your heart? A prospective study of worry and coronary heart disease in the normative aging study. *Circulation*, 95(4), 818-824. <https://doi.org/10.1161/01.CIR.95.4.818>
- Laux, L., Glanzmann, P. G., Schaffner, P., & Spielberger, C. D. (1981). *Das State-Trait-Angstinventar*. Weinheim: Beltz Test.
- Molenaar, P. C. M. (2004). A manifesto on psychology as idiographic science: Bringing the person back into scientific psychology, this time forever. *Measurement: Interdisciplinary Research and Perspectives*, 2, 201–218. https://doi.org/10.1207/s15366359mea0204_1
- Mroczek, D. K., Stawski, R. S., Turiano, N. A., Chan, W., Almeida, D. M., Neupert, S. D., & Spiro, A. (2015). Emotional reactivity and mortality: Longitudinal findings from the VA normative aging study. *The Journals of Gerontology. Series B, Psychological Sciences and Social Sciences*, 70, 398–406. <https://doi.org/10.1093/geronb/gbt107>
- Muthén, L. K., & Muthén, B. O. (1998-2017). *Mplus user's guide* (8th ed.). Los Angeles, CA: Authors.
- Ong, A. D., Exner-Cortens, D., Riffin, C., Steptoe, A., Zautra, A., & Almeida, D. M. (2013). Linking stable and dynamic features of positive affect to sleep. *Annals of Behavioral Medicine*, 46, 52–61. <https://doi.org/10.1007/s12160-013-9484-8>

- Ottaviani, C., Thayer, J. F., Verkuil, B., Lonigro, A., Medea, B., Couyoumdjian, A., & Brosschot, J. F. (2016). Physiological concomitants of perseverative cognition: A systematic review and meta-analysis. *Psychological Bulletin*, 142(3), 231-259. <http://dx.doi.org/10.1037/bul0000036>
- Pieper, S., Brosschot, J. F., van der Leeden, R., Thayer, J. F. (2010). Prolonged cardiac effects of momentary assessed stressful events and worry episodes. *Psychosomatic Medicine*, 72(6), 570-577. <https://doi.org/10.1097/PSY.0b013e3181dbc0e9>
- Polizzi, C., Lynn, S.J., Perry, A. (2020). Stress and coping in the time of COVID-19: Pathways to resilience and recovery. *Clinical Neuropsychiatry*, 17(2), 59-62. <https://doi.org/10.36131/CN20200204>
- Purdon, C., & Harrington, J. (2006). Worry in psychopathology. In G. C.L. Davey & A. Wells (Eds.), *Worry and its psychological disorders* (pp. 41–50). Chichester, UK: John Wiley & Sons Ltd.
- R Core Team (2017). R: A language and environment for statistical computing [Computer software]. Vienna, Austria. Retrieved from <https://www.R-project.org/>
- Rammstedt, B., & John, O. P. (2005). Kurzversion des Big Five Inventory (BFI-K). *Diagnostica*, 51(4), 195–206. <https://doi.org/10.1026/0012-1924.51.4.195>
- Sánchez-Meca, J., Rosa-Alcázar, A. I., Marín-Martínez, F., & Gómez-Conesa, A. (2010). Psychological treatment of panic disorder with or without agoraphobia: A meta-analysis☆. *Clinical Psychology Review*, 30(1), 37–50. <https://doi.org/10.1016/j.cpr.2009.08.011>
- Sibrava, N. J., & Borkovec, T. D. (2006). The cognitive avoidance theory of worry. In G. C.L. Davey & A. Wells (Eds.), *Worry and its psychological disorders* (pp. 239–256). Chichester, UK: John Wiley & Sons Ltd.

- Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. (1970). *State-trait anxiety inventory, manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologist Press.
- Thompson, R. R., Garfin, D. R., Holman, E. A., & Silver, R. C. (2017). Distress, worry, and functioning following a global health crisis: A national study of Americans' responses to Ebola. *Clinical Psychological Science*, 5(3), 513–521.
<https://doi.org/10.1177/2167702617692030>
- Thompson, R. R., Jones, N. M., Holman, E. A., & Silver, R. C. (2019). Media exposure to mass violence events can fuel a cycle of distress. *Science Advances*, 5(4), eaav3502.
<https://doi.org/10.1126/sciadv.aav3502>
- Tully, P. J., Cosh, S. M., Baune, B. T. (2013). A review of the effects of worry and generalized anxiety disorder upon cardiovascular health and coronary heart disease. *Psychology, Health & Medicine*, 18(6), 627-644.
<https://doi.org/10.1080/13548506.2012.749355>
- Wahl, K., Ehring, T., Kley, H., Lieb, R., Meyer, A., Kordon, A., . . . Schönfeld, S. (2019). Is repetitive negative thinking a transdiagnostic process? A comparison of key processes of RNT in depression, generalized anxiety disorder, obsessive-compulsive disorder, and community controls. *Journal of Behavior Therapy and Experimental Psychiatry*, 64, 45–53. <https://doi.org/10.1016/j.jbtep.2019.02.006>
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, R. C. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *International Journal of Environmental Research and Public Health*, 17(5).
<https://doi.org/10.3390/ijerph17051729>

Waugh, C. E., Shing, E. Z., & Furr, R. M. (2020). Not all disengagement coping strategies are created equal: Positive distraction, but not avoidance, can be an adaptive coping strategy for chronic life stressors. *Anxiety, Stress, and Coping*, 1–19.

<https://doi.org/10.1080/10615806.2020.1755820>

Wichers, M. (2014). The dynamic nature of depression: A new micro-level perspective of mental disorder that meets current challenges. *Psychological Medicine*, 44(7), 1349–1360.

<https://doi.org/10.1017/S0033291713001979>

Witthöft, M., Freitag, I., Nußbaum, C., Bräscher, A.-K., Jasper, F., Bailer, J., & Rubin, G. J. (2018). On the origin of worries about modern health hazards: Experimental evidence for a conjoint influence of media reports and personality traits. *Psychology & Health*, 33(3), 361–380. <https://doi.org/10.1080/08870446.2017.1357814>

Tables and Figures

Table 1

Descriptive Statistics, Reliabilities, and Bivariate Correlations of All Measures

	1	2	3	4	5	6
Range of Scale	1-5	1-5	1-7	1-7	1-5	1-4
Minimum/Maximum	1/5	1/5	1/7	1/7	1/5	1/3.9
<i>M</i> (<i>SD</i>)	2.67 (0.73)	2.07 (0.82)	3.66 (1.36)	3.76 (1.55)	2.89 (0.96)	2.33 (0.62)
<i>ICC</i>	.45	.55	.47	.53	--	--
<i>M</i> <i>ISD</i> (<i>SD</i>)	0.69 (0.28)	0.63 (0.35)	1.24 (0.54)	1.27 (0.60)	--	--
1. Daily COVID-19-related Media Exposure	--	.63	.70	.50	.08	.16
2. Daily COVID-19-related Social Media Exposure	.53	--	.50	.43	.12	.18
3. Daily COVID-19-related Thoughts	.49	.38	--	.86	.28	.37
4. Daily COVID-19-related Worries	.35	.28	.62	--	.36	.47
5. Trait Neuroticism	--	--	--	--	.82	.58
6. Trait Anxiety	--	--	--	--	--	.95

Note. *M* = Mean; *SD* = standard deviation. Reliabilities (McDonald's ω) are printed in bold and are presented in the diagonal. Within-person correlations of daily measures are presented below the diagonal, while all between-person correlations are presented above the diagonal. All correlations were significant at $p < .05$.

Figure 1*Average COVID-19-Related Media Exposure and Worries Across Study Days*

Note. The black line shows average COVID-19-related media exposure (left y-axis, Panel A) and worries (left y-axis, Panel B) and their standard errors for each study day as indicated by respective date (x-axis, Panels A and B). The bold lines represent the fixed trends in COVID-19-related media exposure (Panel A) and worries (Panel B) based on respective piecewise

growth curve model. Bars (right y-axis, Panels A and B) indicate the number of available observations at each study day. At April 15th 2020, the German government announced the extension of COVID-19-related restrictions. Note that at the last three study days, there was a maximum of three participants per day.

accepted

Figure 2*Schematic Presentation of the Main Findings of Multilevel SEM*

Note. Rectangles represent observed variables and ovals refer to latent variables. Presented are standardized parameter estimates of fixed effects with corresponding 95% credible intervals in parentheses. The dotted line indicates that respective parameter estimate was not statistically meaningful.

Table 2*Results of the Dynamic Structural Equation Model Examining Across-Day Associations**Between COVID-19-Related Media Exposure and COVID-19-Related Worries (N = 561)*

	Standardized estimates [95% credible interval]
Within-person effects	
<i>Autoregressive effects</i>	
Media exposure	0.10 [0.06, 0.13]
Worries	0.09 [0.05, 0.12]
<i>Cross-lagged effects</i>	
Worries→Media exposure	0.09 [0.05, 0.12]
Media exposure→Worries	0.05 [0.02, 0.08]
<i>Covariates</i>	
Weekend ^a →Media exposure	-0.16 [-0.19, -0.13]
Weekend ^a →Worries	-0.16 [-0.18, -0.13]
Between-person effects	
<i>Covariates</i>	
Trait neuroticism→Media exposure	0.01 [-0.09, 0.11]
Trait neuroticism→Worries	0.12 [0.03, 0.21]
Trait anxiety→Media exposure	0.17 [0.07, 0.27]
Trait anxiety→Worries	0.37 [0.28, 0.46]
Weekend ^a →Media exposure	-0.40 [-0.62, -0.11]
Weekend ^a →Worries	-0.18 [-0.42, 0.09]
<i>Moderator effects</i>	
Trait neuroticism*Media exposure→Media exposure	0.06 [-0.19, 0.32]
Trait anxiety*Media exposure→Media exposure	-0.16 [-0.42, 0.10]
Trait neuroticism*Worries→Worries	-0.05 [-0.28, 0.18]
Trait anxiety*Worries→Worries	0.13 [-0.10, 0.35]
Trait neuroticism*Worries→Media exposure	-0.02 [-0.31, 0.27]
Trait anxiety*Worries→Media exposure	0.24 [-0.06, 0.51]
Trait neuroticism*Media exposure→Worries	0.14 [-0.19, 0.48]
Trait anxiety*Media exposure→Worries	-0.19 [-0.55, 0.17]

Note. Presented are standardized regression coefficients (95% credible intervals in parentheses). Parameters whose 95% credible interval does not contain zero are printed in bold.

^a 0 = weekday, 1 = weekend/holiday.