



# COVID-19 news valence effects on emotion and its modulation by a relaxation: A randomized online experiment during COVID-19 pandemic

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## ABSTRACT

This study evaluated how news with positive and negative content about COVID-19, as well as a relaxation pause, affect the emotional state. We also investigated the association between emotional state and practicing meditation/yoga, physical activity or having a mental disease. For that, a sample of 717 participants, recruited through social media, were randomly assigned to listen to negative or positive news about COVID-19. After that, both groups were guided through a short relaxation pause. Their emotional state was measured before they listened to the audios and after each audio. Mixed linear models were used to evaluate the effects of news group, relaxation pause, mental health and well-being practices. Negative news worsened their emotional state, whereas positive news improved it. A brief relaxation pause improved the effects of negative news content and may mitigate the effects of this valence of information. Practicing physical activity, meditation/yoga was associated with better emotional responses.

## 1. Introduction

We have been getting a lot of news about COVID-19, since the World Health Organization declared the new coronavirus outbreak a pandemic (O'Connor and Murphy, 2020; Orso et al., 2020; World Health Organization, 2020). This increased volume of information consumption might be harmful. For example, increased exposure to social media about the coronavirus was positively associated with the prevalence of anxiety, depression, and a combination of both, as verified in an online survey in China (Gao et al., 2020). Similar relations between psychological distress and information consumption or social media use were found in other countries as well (Bazán et al., 2020; Hammad and Alqarni, 2021; Mongkhon et al., 2021; Piltch-Loeb et al., 2021). The changes in the emotional state of health care professionals due to the valence of news about the coronavirus were evaluated just after they listened to audios with positive or negative content. Negative news immediately worsened their emotional state (Bazán et al., 2021).

These potential deleterious effects of information overload during the pandemic have been termed "infodemic" (Farooq et al., 2020; Freiling et al., 2021; Rovetta and Bhagavathula, 2020). On the other hand, even though media consumption during the COVID-19 pandemic can have negative impacts, it can possibly also have positive effects if

they report heroic acts or provide helpful and trustful information, as in speeches from experts, based on survey data (Chao et al., 2020). Another survey also suggested that factual and positive information or positive interactions in social media may help coping with the pandemic (Pahayahay and Khalili-Mahani, 2020). Indeed, not all types of news have the same impact.

Previous studies with controlled news stimuli have suggested that listening to positive and to negative news affect emotional responses differently (Veitch and Griffith, 1976). Similar effects have been reported when reading news, with a positive affect being elicited by positive news, compared to the effects of bad news (McIntyre and Gibson, 2016). Therefore, the infodemic context suggests that the effects of COVID-19 news should be further evaluated in a controlled experimental setup.

Apart from understanding the impact of news consumption, seeking alternatives to minimize the negative effects should also be a goal during the pandemic. To minimize the effects of negative news on our emotions and to improve well-being, contemplative practices such as meditation have been recommended (Bushell et al., 2020). Short relaxation pauses—paying attention to one's body and breath (Kozasa et al., 2020), daily guided meditations (Szabo and Hopkinson, 2007), yoga (Basso et al., 2019) and physical activity (Daly et al., 2015; Phillips and Fahimi, 2018) have been shown to reduce stress symptoms and improve emotional

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regulation. A recent review discussed the association between physical activity and mental health during the pandemic (Violant-Holz et al., 2020). A few studies suggested positive effects of online yoga and mindfulness meditation programs on well-being and reduction of stress during the COVID-19 outbreak (Divya et al., 2021; Jasti et al., 2020; Luberto et al., 2020; Matiz et al., 2020). However, the relation between practicing yoga, mindfulness or meditation and mental health during the pandemic has been in inconsistent in surveys (Conversano et al., 2020; Jiménez et al., 2020; Vogel et al., 2021). Further, it is unknown if physical activity, yoga or meditation practices alter the effect of COVID-19 news.

The aim of this study was to evaluate how news with positive and negative content about COVID-19 affect emotional state and whether a brief relaxation pause intervention may improve such emotional state. We also investigated the association between emotional state and practicing physical activity, meditation/yoga or having a mental disease. We hypothesized that a short audio track with negative news content may worsen our emotional state and one with positive news may improve it. A relaxation pause should promote an improvement in the emotional state of both groups, especially in participants who listened to the negative content. Further, well-being practices (yoga and physical activities) may also have positive effects on the emotional state and on news impact.

## 2. Material and methods

### 2.1. Transparency and openness

In this article, all data exclusions and all measures that were included in the study are reported, and the STROBE reporting guideline was followed (S1). The demographic questions, and the questionnaire to assess emotional state are described in detail, and the original Portuguese versions are provided as Supplementary materials (S2 and S3). The analysis code is also provided as Supplementary material (S4). The code generates a brief report of the results which is provided as Supplementary material (S5). Further, the experimental audios in Portuguese and an English transcription are available in the Supplementary materials (S6–S11). All analyses were run using the statistical programming language R version 4.0.4 (Grolemund and Wickham, 2011; Revelle, 2020) and packages (Bates et al., 2014; Edwards, 2020; Grolemund and Wickham, 2011; Henry et al., 2016; Hester et al., 2020; Kassambara, 2020a, 2020b; Lüdtke, 2020; RCoreTeam, 2020; Revelle, 2020; Rich, 2020; Rodriguez-Sanchez, 2018; Wickham, 2011; Wickham et al., 2019; Wickham et al., 2020; Wickham and Seidel, 2020; Wickham and Wickham, 2019). Requests to access the original data can be made to the corresponding author, as they must be evaluated by the local ethics committee. This study was not preregistered, neither its analysis

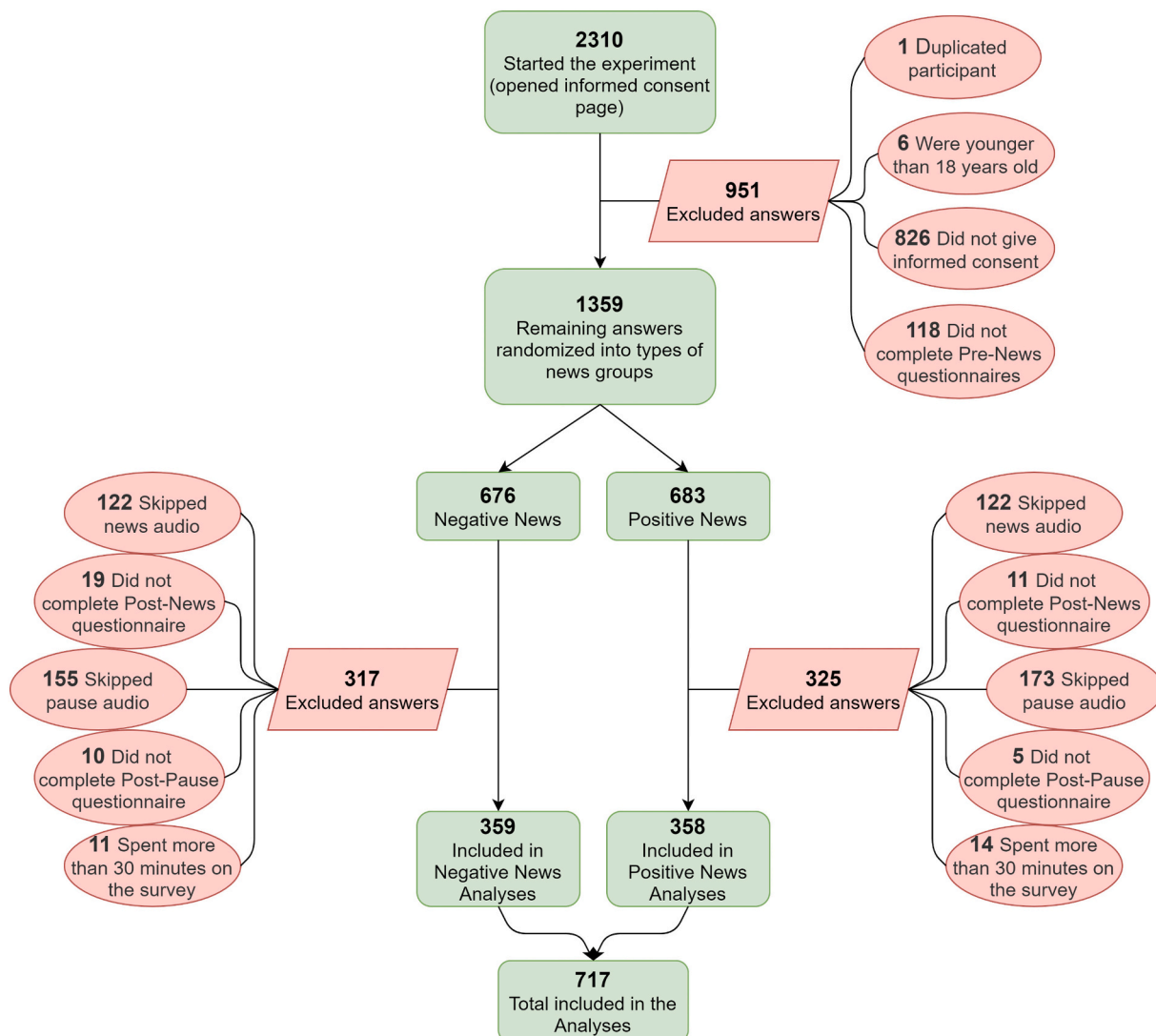


Fig. 1. Flow chart of the inclusion of the participants.

plan.

### 2.2. Participants

People were invited to participate in this study through social media (WhatsApp, Instagram, Facebook, Twitter and LinkedIn) in June of 2020 (survey available between June 10 and June 30). A convenience sample of 2310 volunteers opened the informed consent page, of which 1359 signed it and were randomized to either received positive (N = 683) or negative (N = 676) audio track news about COVID-19. After applying exclusion criteria, our final sample was composed of 358 and 359 participants that listened to a positive or negative content audio track news, respectively, and were included in the analysis (Fig. 1).

Inclusion criteria: availability of time to participate in the experiment (approximate time of 10 to 15 min) and being 18 or older.

Exclusion criteria: participants who did not complete the experiment (did not complete the survey questions or did not listen to the entire audios) or took more than 30 min to finish it. The study was approved by the Ethics Committee of Hospital Israelita Albert Einstein (CAAE 32339420.2.0000.0071).

### 2.3. Emotional State Scale (ESS)

This scale was developed to capture the emotional states of participants. The scale contains 9 Likert items, with scores ranging from 0 to 10, to score how irritated, preoccupied, anxious, stressed, hopeful, despondent, optimistic, joyful and conscious about emotions someone is feeling in a giving moment (see Supplementary material S3). To obtain a total score, we reversed positive items scores (i.e. happy, optimistic, hopeful, and conscious) and all item scores were added. Higher scores indicate a more negative emotional state. The ESS presented high reliability (Cronbach's  $\alpha = 0.81$ ) in the pre interventions data.

### 2.4. Procedure

Participants were randomly assigned either to the Negative News (NN) or Positive News (PN) groups soon after signing the Informed Consent to enter the study. ESS was the first item presented to participants at baseline (time = 0). After that, the NN and PN groups listened to a negative or positive content audio track about COVID-19, respectively. Audio tracks had a duration of 2 min and 3 s, and the number of short stories reported in the audio news were balanced across groups. The content of the audio tracks was real news about the pandemic which happened in 2020 (see Supplementary materials S6–S11). Both groups answered the ESS questions again after listening to the audio files. After ESS assessment, both groups listened to an audio file with a relaxation pause (3 min and 19 s), which instructed participants to pay attention to their breathing and relax their bodies. After the relaxation audio, participants answered the ESS one last time.

All data were collected online avoiding any kind of bias and the flow chart describe the details of the participants who entered in the statistical analysis (Fig. 1).

### 2.5. Statistical analysis

Effects of each one of the three audio tracks (positive and negative news and a relaxation pause) on participants feelings were assessed using the overall score (sum of all items after inversion of positive items) as an outcome measure and, binary variables related to physical activities, meditation/yoga, and being under psychological or psychiatric treatment were used in a linear mixed model. We evaluated five models and compared them by using Akaike information criterion (AIC) and Bayesian information criterion (BIC) in order to choose the combination of regressors that yielded the model that best fit the data: 1) only news group and time main effects and interaction; 2) adding the main effects

of three variable related to well-being practices and psychological or psychiatric treatment; 3) adding the interaction between these three variables; 4) adding time interactions with well-being and psychological or psychiatric treatment variables; 5) a full model with news group, time, well-being and psychological or psychiatric treatment main effects and interactions. The model with smaller AIC and BIC values was used in further analysis and used for interpretation of the results. Linear model assumptions were checked (linearity, normality of residuals and homoscedasticity) using the appropriate plots (Supplementary material S5). An analysis of deviance (ANODE) using Type III Wald F tests with Kenward-Roger degrees of freedom was used to test the significance of the effects of the model, followed by pairwise *t*-tests with Bonferroni correction as post-hoc tests. We supplemented our analyses by presenting Cohen *d* effect size estimates for factors with more than two levels (Time and Group \* Time interactions).

## 3. Results

Participants were predominantly female (79.2%) with a mean age of  $43.4 \pm 13.7$ . Most of the respondents presented a high level of education (Graduate, MBA, MSc, PhD:  $n = 425$  (59.3%)) and were working or studying during the period of the interview ( $n = 529$  (73.8%)). Regarding the incomes the sample presented good representation in the different categories. Something curious about this sample is the number of physically active and meditation/yoga practitioners (Physical activities:  $n = 305$  (42.5%); Meditation/Yoga:  $n = 270$  (37.7%)) (Table 1).

The five-model comparison indicated that the mixed linear model that best fit the data (lower AIC and BIC values) contained news group and time main effects and their interaction, and main effects of three variables related to well-being practices and psychological treatment (Table 2). Therefore, this model was used in further analysis.

**Table 1**  
Sociodemographic information.

	Total (N = 717)
Gender	
Female	568 (79.2%)
Male	148 (20.6%)
Other	1 (0.1%)
Age groups (years)	
<25	49 (6.8%)
25–34	165 (23.0%)
35–44	188 (26.2%)
45–54	148 (20.6%)
55–64	106 (14.8%)
≥65	61 (8.5%)
Education	
Primary education	1 (0.1%)
Lower secondary	6 (0.8%)
Higher secondary	29 (4.0%)
Undergraduate/Bachelor	256 (35.7%)
Graduate, MBA, MSc, PhD	425 (59.3%)
Monthly income <sup>a</sup> (in Brazilian reais)	
R\$0,00–R\$1.045,00	21 (2.9%)
R\$1.045,01–R\$3.135,00	98 (13.7%)
R\$3.135,01–R\$6.270,00	156 (21.8%)
R\$6.270,01–R\$9.405,00	101 (14.1%)
R\$9.405,01–R\$12.540,00	106 (14.8%)
R\$12.540,01–R\$15.675,00	61 (8.5%)
R\$15.675,00 or more	174 (24.3%)
Currently working or studying	529 (73.8%)
Group	
Positive information	359 (50.1%)
Negative information	358 (49.9%)
Mental health and well-being practices	
Psychological or psychiatric care	139 (19.4%)
Physical activities	305 (42.5%)
Meditation/yoga	270 (37.7%)
Other(s)	89 (12.4%)
None	207 (28.9%)

<sup>a</sup> Brazilian minimum wage (R\$ 1045.00).

**Table 2**  
Linear mixed models comparison and selection.

Model	Number of parameters	AIC <sup>a</sup>	BIC <sup>b</sup>
Only Group and Time effects and interaction	8	16,467	16,512
Adding the main effects of well-being practices and treatment <sup>c</sup>	11	16,430	16,492
Adding the interaction between well-being practices and treatment	15	16,432	16,517
Adding the Time interactions with well-being practices and treatment	29	16,436	16,601
Full model (all main effects and interactions)	50	16,459	16,743

<sup>a</sup> Akaike information criterion.  
<sup>b</sup> Bayesian information criterion.  
<sup>c</sup> Lower AIC and BIC values (chosen model).

The results from the best linear mixed model indicated that the ESS score was modulated by news group, time, treatment, physical activity and meditation/yoga, as well as the interaction between news group and time ( $P \leq 0.001$ ). Further investigating these effects, we observed that PN and NN groups were similar at baseline (PN:  $42.9 \pm 15.3$ ; NN:  $42.1 \pm 14.3$ ; corrected  $P = 1$ ; Cohen  $d = -0.05$ ) and that, after listening to the audio track news, NN group ( $50.5 \pm 15.6$ ) increased their ESS scores compared to the positive news (PN) group ( $37.3 \pm 15.8$ ) (corrected  $P < .001$ ; Cohen  $d = 0.84$ ). In addition, both groups decreased their ESS scores after the relaxation pause in comparison to after audio news (PN: corrected  $P < .001$ ; Cohen  $d = 0.65$ ; NN: corrected  $P < .001$ ; Cohen  $d = 1.04$ ) and to the initial assessment before audio news (PN: corrected  $P < .001$ ; Cohen  $d = 1.04$ ; NN: corrected  $P < .001$ ; Cohen  $d = 0.68$ ), indicating beneficial effect of this practice (Fig. 2).

Although the NN group decreased their ESS score after listening to the relaxation pause, they still presented higher levels of negative emotional state than the PN group (NN:  $35.5 \pm 15.3$ ; PN:  $32.1 \pm 15.5$ ; corrected  $P = .012$ ; Cohen  $d = 0.22$ ). Detailed tables of these results are provided as Supplementary material (S5).

The results also indicated that having a diagnosis of mental disease and being under psychological or psychiatric treatment is associated with more negative emotional state. Practicing physical activities as well as meditation/yoga are associated with more positive emotional state compared with not practicing any of those activities (Fig. 3, Supplementary material S5).

#### 4. Discussion

The aim of this study was to evaluate how news with positive and negative content about COVID-19 affect the emotional state and whether a brief relaxation pause intervention may improve this emotional state. We also investigated the association between practicing physical activity, meditation/yoga or being under psychological or psychiatric care and the emotional state. To address these issues, we measured emotional state of the participants in 3 moments in a randomized online experiment: before listening to news audio tracks with positive or negative content, after listening to the news, and after practicing a relaxation pause. The results showed that, after listening to negative news, participants were in a more negative emotional state than at baseline and compared with participants who listened to positive news. After practicing the brief relaxation pause, both groups improved their emotional state compared with before the experiment and after listening to the news.

These results show the importance of observing and choosing the content of consumed news, especially in critical moments (pandemics), in which mental health is worsening (Holmes et al., 2020; Lai et al., 2020). Additionally, our results suggest that even a brief relaxation practice can mitigate the effects of consuming information with negative content, as the ESS difference between positive and negative groups after news audio track was smaller following the pause (as suggested by Cohen  $d$  effect size). Further, the brief relaxation seemed to have a general positive effect, given the emotional state improvement in comparison to baseline and even to post positive news state.

To measure the emotional state of the participants, we created a brief new scale instead of using previously validated ones, such as PANAS (Watson et al., 1988). This decision was made with the goal of reducing the time to perform the whole experiment increasing retention of participants, as the dropout rates in online surveys increase after 7–8 min (Chudoba, 2020). Although the Emotional State Scale is not a validated instrument, it presented good internal consistency for the current sample (see Methods section for details) and in a sample of health care professionals (article under review).

Our results show that listening to negative news increases the scores of the participants in the ESS scale, which indicates a more negative emotional state. An ecological study before the pandemic based on a structured diary assessment also found that the more negative the perception of the news, the more negative was the affect experienced by the participants (de Hoog and Verboon, 2020). Negative content news could be a potential danger at this moment of the pandemic due to the high prevalence of mental disorders such as depression and anxiety (González-Sanguino et al., 2020; Lu et al., 2020). In fact, social media

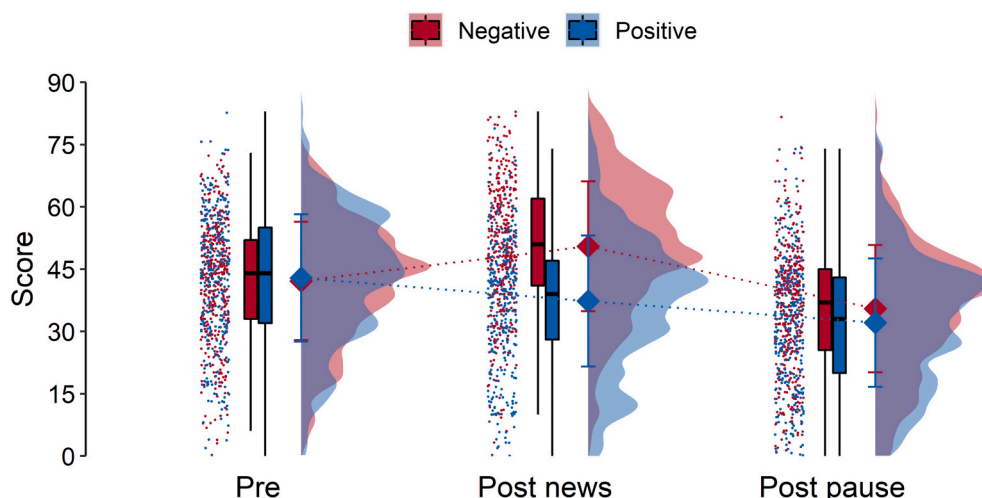
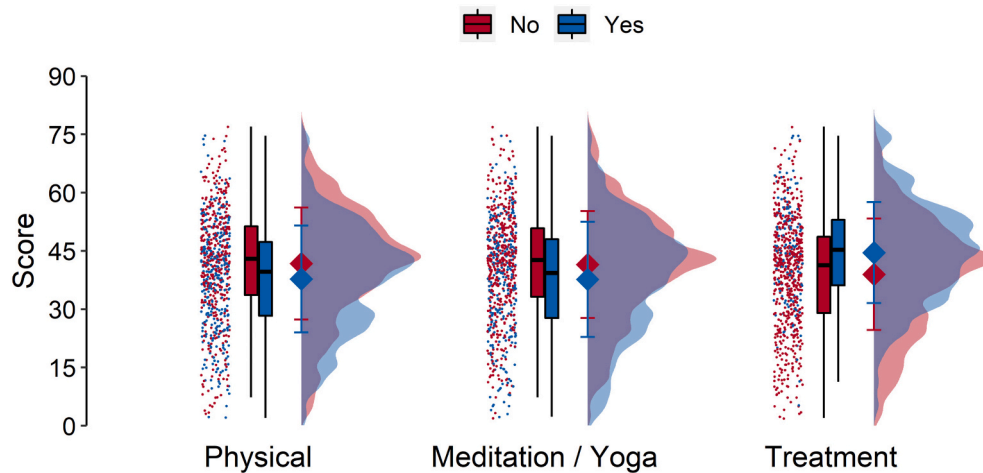


Fig. 2. Emotional state before, post news and post relaxation pause in the positive and negative news groups.



**Fig. 3.** Emotional state in groups who are practicing physical activity, meditation/yoga or present a mental disorder and are under treatment. Note. The scores of the three times are being presented together in each mental health or well-being practice group.

exposure during COVID-19 outbreak has been correlated with depression, anxiety and the combination of depression and anxiety (CDA) symptoms (Gao et al., 2020). Our results are in line with such findings and add that the content of the news might increase their impact on mental health.

In contrast to listening to negative content news, after participants listened to news with positive content, they showed an improvement in their emotional state. Therefore, based on our findings, searching for more positive uptakes on the news would be beneficial. In agreement with this result, preadolescents exposed to constructive news showed more positive emotional responses than to non-constructive news (Kleemans et al., 2017). There is a study which showed that paying attention to positive local news weakened the fear of crime and the feeling of depression (Yamamoto, 2018). Therefore, choosing the news that is consumed may have a positive impact on mental health quality.

Our group, as well as other authors, has shown that practicing a relaxation pause improved the emotional state of the participants (Kozasa et al., 2020; Lacerda et al., 2018; Szabo and Hopkinson, 2007). The current results not only replicate but also extend these findings: compared to previous studies, here we evaluated the effect of a much briefer intervention (~3 min compared to ~15 min) (Basso et al., 2019; Szabo and Hopkinson, 2007). Such a brief intervention makes it easier to introduce a relaxation pause during the daily routine. This relaxation pause consists of relaxing the body and paying attention to the breath in a slow rhythm. This intervention may improve the emotional state of the participant by activating the parasympathetic nervous system and attenuating cardiac autonomic responses and anxiety symptoms (Sakakibara and Hayano, 1996). An improvement in emotional state, however, could also be attributed to the passage of time or a washout effect, because we did not have a control group for the relaxation practice. Although this is a possibility, thus a limitation of the present study, the effects of slowing the respiration rhythm, meditating, and relaxing the body are well established in the literature (Danucalov et al., 2013; Joseph et al., 2005; Laborde et al., 2019; Zaccaro et al., 2018). Also, the fact both groups improved their emotional state after the relaxation practice compared to baseline suggests that it had a positive impact.

It is known that physical activity may improve mental health and well-being, and a few survey studies evaluated physical activity practices regarding mental health during the pandemic (Violant-Holz et al., 2020). However, few studies evaluate specifically the effects of physical activity on emotions. In line with our results, a study found that physical activity may improve the reaction to negative emotions, with maximal effect happening when it was about 2500 METs (ratio of work metabolic rate to a standard resting metabolic rate) weekly (Zhang et al., 2020).

Predictive models revealed that the greatest protector for mental

disorder symptomatology was spiritual well-being (González-Sanguino et al., 2020). Some of the common practices in this field are meditation and yoga and our study has also revealed a better emotional state related to these practices. These results are in line with the benefits suggested by online yoga or mindfulness meditation programs (Divya et al., 2021; Jasti et al., 2020; Luberto et al., 2020; Matiz et al., 2020).

Our model of comparison approach indicated that adding interactions between mental health and well-being practices with either time or news group did not significantly improve the model. Such results suggest that these practices have a general impact on our emotional state, not directly related to news valence effects, or to the relaxation pause effects.

Limitations: The emotional state scale, despite presenting internal consistency in this study, is not validated and the relaxation pause did not have a control washout condition to be compared with. However, the fact that after relaxation pause both positive and negative news groups presented more positive states than after news and at baseline suggests that it is unlikely a washout effect. This study evaluated a convenience sample, therefore we cannot generalize the results for the population.

In the present study, we showed that the valence of COVID-19 news content affected the emotional state of the participants: negative news worsened their emotional state, whereas positive news improved it. In addition, our results suggest that a brief relaxation pause may mitigate the detrimental effects of negative news content. Finally, being under treatment for a mental disorder is correlated with worse emotional state, whereas practicing physical activities as well as yoga/meditation are associated with a better emotional state. These results provide important information to discuss automatic news consumption, specially, during the pandemic.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.invent.2021.100472>.

#### CRediT authorship contribution statement

PRB: Conceptualization of the current project; Participated in the development of the Emotional State Scale and implementation of data acquisition in REDCap; Performed data analysis; Interpretation of data and paper writing and significant revision. RMAN: Conceptualization of the current project; Participated in the development of the Emotional State Scale; Performed data analysis; Interpretation of data, paper writing and significant revision. SSL: Participated in the development of the Emotional State Scale; Performed data analysis; Interpretation of data, paper significant revision. MWR: Interpretation of data, paper significant revision. JBB: Interpretation of data, paper significant

revision. EAJ: Interpretation of data, paper significant revision. EHK: Conceptualization of the current project; Writing of the project; Conceptualized and participated in the development of the Emotional State Scale; Interpretation of data, paper writing and significant revision.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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