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ARTICLE

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# Replicating and Extending Soroka, Fournier, and Nir: Negative News Increases Arousal and Negative Affect

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## Abstract

The negativity bias hypothesis in political communication contends that people are more aroused by negative vs. positive news. Soroka et al. (2019) provide evidence for this negativity bias in a study in 17 countries across six continents. We find suggestive evidence for Soroka et al.'s (2019) central finding that negativity causes an increase in skin conductance levels in a conceptually close, well-powered, and preregistered replication. We extend Soroka et al. (2019) in three ways. First, we theorise, test, and confirm that negative (vs. positive) news causes an increase in activity of the corrugator major muscle above the eyebrow (using facial electromyography activity) and is associated with a negative affect. Second, we find people self-reporting negative news causes negative affect but that positive (instead of negative) news increases self-reported arousal. Third, we test Soroka et al.'s (2019) argument in another context, the Netherlands. Our article suggests that negative news is, especially, causing negative affect. Doing so, we contribute to the negativity bias argument in political communication research and, at the same time, show the importance of replication in empirical communication research.

## Keywords

corrugator; negative news; negativity bias; physiology; skin conductance

## 1. The Negativity Bias in Political Communication Research

In a path-breaking study published in the *Proceedings of the National Academy of Sciences*, Soroka et al. (2019; SFN from here on) found that negative news is more arousing and attention-grabbing compared to positive news. The study was conducted among 1,156 subjects in 17 countries on six continents and revealed that "reactions to video news content reveal a mean tendency for humans to be more aroused by and attentive to negative news" (Soroka et al., 2019, p. 18891). The finding, which deepened and broadened an earlier pilot study by Soroka and McAdams (2015) conducted in Canada, has important implications for political communication as a field. According to Soroka et al. (2019, p. 18888), "the importance of negativity biases for news is relatively clear" as "negativity biases affect news selection, and thus also news production, as well as citizens' attitudes about current affairs."

The work by SFN introduced a new theory in (political) communication research about responses to negative news. In an earlier study, Soroka and McAdams (2015, p. 4) summarised the argument for a negativity bias as follows:

> Humans have a reasonably well-established tendency to react more strongly to negative than to positive information; it follows that news content, created by humans, with the goal of getting attention from other humans, will tend to be biased toward the negative. Critical to this account is evidence that news content does indeed tend to generate stronger reactions and/or greater attentiveness when it is negative.

This innovative argument brings together research in evolutionary psychology—arguing that there are evolutionary benefits to being attuned to negativity—with literature in media systems suggesting that there might be cross-cultural differences in negativity bias. Moreover, SFN advanced the study of responses to news by turning to physiological measures of arousal and attention. This was combined with a unique cross-cultural data collection across six continents, thereby addressing concerns about the focus on the Western context in empirical social science research. The article, although relatively recent, made an impact on the field: It has been widely cited (311 citations in Google Scholar, as of January 11, 2024) and was viewed 167,135 times on the journal's website. The article was also covered in the press by dozens of news outlets including prominent outlets such as *The Washington Post*, *Medium*, *Al Jazeera*, *The Guardian*, *Newsweek*, and *Handelsblatt*, while being referenced on six Wikipedia pages.

The work by SFN has been foundational and, to us, inspirational. At the same time, replications are scarce in communication research (Keating & Totzkay, 2019). Especially direct replications—which closely follow the design and procedures of the original study—are sparse: In the period 2007 to 2016, 0.5% of the published papers were direct replications of a previously published study in the field of communication research (Keating & Totzkay, 2019). Our goal is to increase the percentage of published replication studies (a tiny bit). Therefore, we set out to directly replicate one of the two central findings of SFN. We preregistered that we expect that negative news compared to positive news increases skin conductance levels (SCLs) as an indicator of arousal (H1). It is important to replicate this finding because by closely following the design, stimuli, and measures, we can provide crucial information on the repeatability and robustness of SFN's findings (Chambers, 2017).

Note that we do not replicate the other finding of SFN, that negative news vs. positive news captures more attention, as measured with an increase in heart rate variability. Data collection was part of an omnibus study in which we did not collect heart rate to keep the protocol within the limits of an hour (i.e., attaching instruments for each physiological measure cost time).

Aside from replicating SFN, we follow King (1995) and extend the work of SFN in three ways. First, we theorise that negative news causes an increase in negative affect. SFN theorised and tested the effect of negative news on arousal. Yet, theories in psychology and neuroscience on the structure of affect indicate that affect consists of (at least) two dimensions. Arousal captures the intensity of the affective experience, but this intensity can be both negative and positive. Valence is the second dimension of affect and captures the directionality of the affect, ranging from positive to negative (Schiller et al., 2022). SCLs—which SFN used—capture arousal but do not distinguish the valence of the affective experience (Dawson et al., 2007). To capture valence, we turned to facial electromyography (fEMG) which registers rapid, partially automatic affective responses in the face while participants view stimulus material. fEMG is primarily used as an indicator of emotional valence (Larsen et al., 2003). We focus on the corrugator supercilii muscle region which is the muscle above the eyebrow that draws the brow down and pulls the brows together. The corrugator is used as an indicator of negative affect, also in political communication research. For instance, in response to political communication, messages incongruent with held beliefs produced more corrugator activity (negative affect) than congruent communication (Bakker, Schumacher, & Rooduijn, 2021; Boyer, 2023). We extend SFN and preregistered that we expect that negative news compared to positive news increases the activity of the corrugator muscle (H2).

Second, we broaden SFN by also measuring self-reported valence and arousal. SFN did not collect measures of either but did ask about the "tone of the message" which was: "Please rank this story on the following dimensions….Negativity." That is, however, not the same as measuring the affective response to the message. We agree with SFN that physiological measures have the advantage that they capture affective responses during exposure. At the same time, inspired by ongoing discussions in psychology and neuroscience (e.g., Arceneaux et al., in press; Barrett, 2017; Evers et al., 2014; LeDoux & Pine, 2016), it is valuable to capture different parts of the affective response: the more unconscious physiological responses during exposure and the more reflective evaluations of the affective experience after exposure. Physiological and self-reported affect are often loosely related (Bradley & Lang, 2000). Yet, we follow the implications of SFN and expect effects in similar directions as those reported with physiological measures. Specifically, for arousal, we expect that negative compared to positive news leads to a higher level of self-reported arousal (H3), while for valence we expect that negative compared to positive news leads to a higher level of self-reported negative valence (H4).

Third, and finally, we conducted our study in the Netherlands. Conducting this study in the Netherlands allows us to test the repeatability of SFN in another context. The Netherlands is the 18th country where SFN's argument is tested. By pooling our results with those of SFN, we get one (small) step closer to the population-based estimate of the effect of negativity on arousal.

## 2. Methods

### *2.1. Transparency and Ethics*

We preregistered the study on the Open Science Framework on September 25, 2023 (https://osf.io/w2rkq). This was before we conducted the analyses but after data collection was completed. Deviations from preregistration are clearly flagged and all other tests and procedures should be considered as confirmatory and in line with preregistration. The raw data and code to reproduce the results in R can be found on our OSF page as well. The stimuli materials of SFN cannot be publicly shared due to copyright issues. The study received ethical approval from our ethical review board 2022-AISSR-15445. Participants completed an informed consent form before the start of the study.

### 2.2. Sample and Procedure

In Autumn 2022 and Spring 2023, we recruited a total of 104 participants in an omnibus laboratory study. We conducted the study in the Netherlands at the university laboratory of our university. The study took one hour. In line with the guidelines of our ethics board, participants either received research credits or 15 euros in return for their participation. After preregistered preprocessing steps (see Section 2.3), we have 97 participants in the sample.

Upon signing the informed consent participants completed a survey on Qualtrics. Afterwards, a trained research assistant connected the equipment for skin conductance and fEMG. We recorded physiological responses using the Versatile Stimulus Response Registration Program 1998 (Vsrrp98) software with a sampling rate of 1,000 Hz. The lab equipment was able to reliably and validly capture fEMG activity and skin conductance in earlier work in other domains (see, for instance, Gazendam et al., 2013; Nohlen et al., 2016; Sevenster et al., 2015).

SCLs are measured by passing a small current through two electrodes placed on the skin. The electrodes were attached with adhesive tape on the medial phalanges surfaces of the index and ring finger of the non-dominant hand (Dawson et al., 2007). By keeping the current constant it is possible to measure the flow of the current—what we call skin conductance expressed in microsiemens (Dawson et al., 2007). SCL is a validated measure of arousal (for an introduction see, Settle et al., 2020) and is applied in (political) communication research (e.g., Carlson et al., 2020; Wang et al., 2014)

Activity of the corrugator major is associated with the experience of negative affect (Larsen et al., 2003). We measured this using two 7 mm Ag/AgCl mini-electrodes that we filled with electrolyte gel (Signa, Parker Laboratories). Using double-stick adhesive tape, we placed the two electrodes just above the eyebrow, at the place where the muscle is located (Fridlund & Cacioppo, 1986). A third electrode was placed on the middle of the forehead (just below the hairline) and served as a ground measure. The corrugator has no overlapping muscle groups, has a very limited representation in the motor cortex, and "tends to be bilateral innervated" (Larsen et al., 2003, pp. 776–777). The measurement of the corrugator is therefore less subject to disruptions from the (voluntary) movement of other muscles.

The original protocol of SFN was 25 minutes long. We included the stimuli for this article in a larger omnibus study and did not have space for 25 minutes of news clips. However, as the videos were shown in a random order and the focus was not on specific news items, we decided to select a subset of the videos. We did this in consultation with Soroka (the S in SFN). We picked four videos, two negative and two positive, that were shown in all 17 countries included in SFN. Moreover, the selected stories were consistently rated as negative (in the case of the negative stimuli) and positive in the case of the positive videos (see Figure S3 of the supporting materials in SFN). The negative videos were *Peru*, which describes "the small town of Chimbote burns down," and *Niger*, which describes "current food shortages in Niger." The positive videos were *Gorillas*, which describes "gorillas from a zoo are released into the wild," and *Young Director*, in which "an 11-year-old makes stop-motion films." For details on the validation of the stimuli, we refer to SFN who provide evidence that the videos are valid. Like SFN, we randomised the order in which the four videos were shown.

After each video, participants were asked to self-report the arousal and valence (both on a nine-point scale) that they experienced while watching the videos. We used self-assessment manikins to measure arousal and valence, which is a valid and reliable way to measure self-reported arousal and valence (Bradley & Lang, 1994).

In addition to these stimuli, participants in the protocol evaluated candidates for political office and participated in an immigration framing experiment. These other stimuli are part of other papers. The protocol to replicate SFN was placed in the middle of the omnibus study.

### 2.3. Measures

After data collection, we conducted a visual inspection of our data for indications of (a) broken or malfunctioning electrodes, identified by a signal that drops dramatically, or (b) a loose electrode, identified by an unusual, stable up-and-down pattern, and (c) cross-referenced these unusual events from the log book (our trained lab assistants made notes about unexpected events). After this, we removed cases with clear distortions. We did this blind to the results and the experimental conditions. This procedure is highly similar to SFN. Following this, seven participants were excluded from the skin conductance analysis: three participants were excluded due to non-response, one participant was excluded due to under-responsiveness (both can occur due to equipment failure, e.g., loose sensors or disconnected cables), and lastly, three participants were excluded due to wrong synchronisation (i.e., the durations of baseline and/or experimental periods were wrongly recorded).

As for preprocessing the raw SCLs, similar steps as those taken by SFN were performed. A rolling average was applied within each participant by attributing slightly larger weights to the middle three values. This serves to smooth the raw scores, reducing the presence of possible outliers. To address the missing values that are produced due to the procedure at the beginning and end of each participant's time series, the closest available score was used to populate these gaps. Consequently, the normalised SCL (nSCL) was centred on the basis of the mean score of the preceding baseline period. SFN calculate the mean score after excluding the first and last five seconds of the baseline period. Given that our baseline period only spans eight seconds, we preregistered to not apply this step in our data but to take the full eight seconds baseline. We also preregistered to re-analyse the results using the last five seconds of the baseline and our results are not affected by this modelling decision.

The preprocessing for the raw fEMG data is as follows: First, the raw fEMG data is band-pass filtered between 20 and 400 Hz, with an additional 50-Hz notch filter and subsequently integrated (van Boxtel, 2010). fEMG data is further corrected using a Hampel filtering algorithm to filter for cross-talk (Bhowmik et al., 2017) and exclude outliers (observations higher or lower than four standard deviations from the mean). We take an individual time-specific baseline measure by taking the median of all fEMG observations during the interstimulus interval prior to the treatment. We then take the processed fEMG signal and divide it by the baseline with 100. This way the fEMG value represents the microvolt increase or decrease compared to an individual's fEMG readings prior to the treatment.

### 2.4. Analyses and Power

We rely on frequentist statistics and use the $p$-value of $p < 0.05$ as the cut-off for statistical significance. We engage in the more conservative two-sided tests. The analysis strategy per hypothesis is discussed in the results section. We present $z$-standardised coefficients to ease interpretation.

For all our analyses we conducted a power analysis after we completed data collection (the stopping rule for the data collection was decided by other parts of this omnibus study). For details, we refer to the pre-analysis plan (https://osf.io/w2rkq). The power analyses demonstrate that we are sufficiently powered ($\beta = 0.8$, $\alpha$ (two-sided) $= 0.05$) to detect small effects—based upon previous studies (Lakens, 2022)—for our tests of SCLs (arousal; H1) and corrugator activity (valence; H2) captured with physiological measures as well as valence captured with self-reports (H4). When it comes to self-reported arousal, it depends on the population-based effect size one would expect to conclude whether we are sufficiently powered. We expect small effects as the impact of news negativity on self-reported arousal is more ambiguous (the cognitive counterpart of the SCLs; Keib et al., 2018; Ravaja et al., 2015). It is therefore unclear whether our study has enough power to detect an arguably small treatment effect of negativity (vs. positivity) on self-reported arousal.

## 3. Results

The results section is structured as follows: We discuss the preregistered modelling strategy that belongs to the test of the hypothesis, followed by the results and, where appropriate, exploratory extensions. In each section, we flagged deviations from the preregistration.

### 3.1. Negative News Is Causing Increases in SCL (H1)

In line with SFN, the first hypothesis stated that negative news compared to positive news increases SCLs as an indicator of arousal. Participants (97 included in the analyses after preprocessing) saw four videos, lasting approximately one minute and 45 seconds. At the second-per-second level, this yields a total of 40,470 observations. The primary model that we used to test H1 is the fixed-effects within panel estimation of nSCL (for the report of these results, see Table S4 of the supporting information of SFN). The estimation was performed via the plm package (Version 2.6–3; Croissant & Millo, 2008) in R. In this model, the change in nSCL is predicted by a second-by-second negativity score of the video (provided by SFN), while controlling for the logarithm of seconds per video as well as the interaction with the negativity score, the lag of the dependent variable and story order. Note that a reanalysis of the original (preprocessed) data of SFN in R (as well as Stata), using this modelling strategy yielded the same outcomes as presented in the article and appendix by SFN; we thereby verified the results of SFN which is a good starting point for a replication study (Nuijten et al., 2018). A fixed-effects within panel estimation is equivalent to performing a dummy least squares (an ordinary least squares which includes dummies for each unit). This is confirmed by the original data and 2,000 simulated datasets. To conclude, the model we use to test H1 is the following:

$$\begin{aligned}\text{Changes in nSCL} = {} & \text{Negativity} + \text{Time (seconds, logged)} + \text{Negativity} \times \text{Time (seconds, logged)} \\ & + \text{Lagged nSCL} + \text{Story order}\end{aligned}$$

For H1 to be confirmed, we expected a positive and statistically significant effect of negativity. We find a positive but not statistically significant effect of negativity on SCLs ($\beta = 0.019$, $t = 0.984$, $p = 0.325$). This is a small effect in the hypothesised and preregistered direction but it is not statistically significant at the preregistered $p$-value cut-off. This small effect of negativity on SCLs also becomes apparent when inspecting the average SCLs over time (Figure 1), as there are small differences in SCL per condition.

Yet, when comparing the standardised negativity estimate from the article by SFN (2019; $\beta = 0.042$, CI = [0.032, 0.052]) and our replication ($\beta = 0.019$, CI = [−0.019, 0.056]), the estimates are in the same direction and while the confidence intervals overlap, our effect is 2.5 times smaller than SFN. For ease of comparison, Table 1's first column provides our replication model and SFN's model in parallel to each other.

Next, we performed an exploratory non-preregistered test to assess whether the negativity coefficient found by SFN differs from our outcome. We pooled the data from SFN and our replication sample. Consequently, we ran the pre-specified model on the pooled data adding two predictors: whether the respondent originated from the sample by SFN or the replication, and an interaction of the sample origin with the negativity coefficient. The latter would indicate whether the negativity coefficient differs significantly between samples. Given that fixed-effects within estimation cannot account for time-invariant features, which is the case for the sample origin as a respondent always belongs to the same sample, we ran a random-effects model instead. We find no support for the hypothesis that our coefficient is statistically significantly different than the one found by SFN: The interaction effect between the negativity indicator

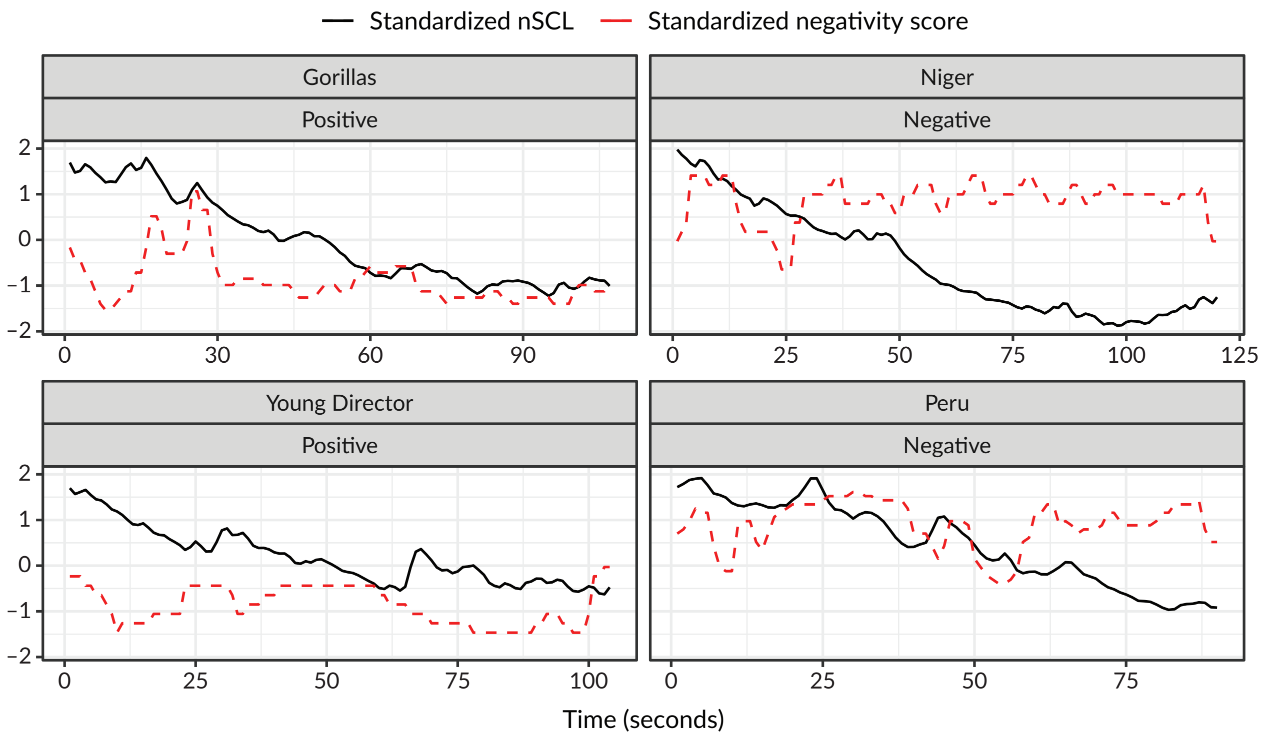


**Figure 1.** Average nSCL time series per story. Notes: The panels plot the average SCL per clip; the top of each panel indicates the name of the panel and whether its valence is positive or negative; the black line in each panel projects the $z$-standardised mean SCL activity over the seconds (x-axis) per video treatment (panel); the red line plots the $z$-standardised negative score of the video as scored per second and provided by SFN; the negativity score ranges from negative (positive values on the y-axis) to positive (negative values on the y-axis).

and the dummy variable capturing whether it was SFN's sample (0) or our replication sample (1) was very close to zero and not statistically significant, with $\beta = -0.002$, $t = -0.448$, and $p = 0.654$ (see Model 4, the pooled model with sample controls, in Table 1).

Comparing our effect to SNF's, we find no statistically significant difference. This, however, raises the question of the practical significance of our effect. For this, we turn to exploratory non-preregistered equivalence testing to determine whether our effect is practically equivalent to 0. When we use the parameters package (Version 0.21.3; Lüdecke et al., 2020) and assume the default bounds our negativity effect falls within the bounds of what is practically equivalent to 0, with CI 90% [–0.01, 0.05], range of practical equivalence [–0.1, 0.1], and $p < 0.001$. This suggests that our effect can be labelled as negligible.

However, we can also use the heuristic by Simonsohn (2015). This states that the smallest effect size of interest is the minimum effect size that the original study could have detected with 33% power. In the case of SNF, this is a $\beta$ of 0.0018. Using this effect size as the upper (0.0018) and lower (–0.0018) bound, we conclude that our effect is not equivalent to 0. To put it differently, our effect is different from zero and falls within the bounds of SFN, CI 90% [–0.01, 0.05], range of practical equivalence [–0.0018, 0.0018], and $p = 0.954$.

To summarise, our study failed to replicate the statistical significance of the effect reported by SFN. Exploratory equivalence tests suggest that our SCL effect falls within the bounds of SFN, but its practical significance depends on the bounds chosen in the equivalence test. When we pool our data with SFN, we get a smaller yet statistically significant estimate of the effect of negativity on SCL (see Models 3 and 4 in Table 1).

**Table 1.** Effect of negativity on standardised change in nSCL.

| | Standardised change in nSCL | | | |
|---|---|---|---|---|
| | Replication | SFN | Pooled | Pooled with sample controls |
| Time (seconds, logged) | –0.006<br>(0.006) | –0.004***<br>(0.001) | –0.001<br>(0.001) | –0.001<br>(0.001) |
| Time × Negativity | –0.006<br>(0.005) | –0.011***<br>(0.001) | –0.010***<br>(0.001) | –0.010***<br>(0.001) |
| Lagged nSCL | –0.100***<br>(0.006) | –0.082***<br>(0.001) | –0.059***<br>(0.001) | –0.059***<br>(0.001) |
| Order | 0.010**<br>(0.004) | –0.004***<br>(0.0003) | –0.003***<br>(0.0003) | –0.003***<br>(0.0003) |
| Negativity | 0.019<br>(0.019) | 0.042***<br>(0.005) | 0.039***<br>(0.005) | 0.040***<br>(0.005) |
| Negativity x Replication sample | | | | –0.002<br>(0.004) |
| Replication sample | | | | –0.023***<br>(0.005) |
| Observations | 40,346 | 641,287 | 681,633 | 681,633 |
| $R^2$ | 0.008 | 0.005 | 0.003 | 0.003 |
| Adjusted $R^2$ | 0.005 | 0.003 | 0.003 | 0.003 |
| $F$ statistic | 63.630*** | 628.749*** | 2,163.547*** | 2,182.103*** |

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

### 3.2. Negative News Is Causing Increases in Corrugator Activity (H2)

The second hypothesis stated that negative news would elicit more corrugator activity in the supercilii (as expressed through the fEMG measure). Similarly, as for nSCL, we use the fixed effects within panel estimation to analyse the effect of negativity on fEMG. The change in the corrugator variable is regressed on the second-by-second negativity score of the video while controlling for the logarithm of seconds per video as well as the interaction with the negativity score, the lag of the dependent variable, and story order:

$$\text{Changes in corrugator} = \text{Negativity} + \text{Time (seconds, logged)} + \text{Negativity} \times \text{Time (seconds, logged)}$$
$$+ \text{Lagged corrugator} + \text{Story order}$$

The interaction effect between negativity and time is in the predicted positive direction and close to the preregistered $p$-value cut-off $p < 0.05$ ($\beta = 0.038$, $t = 1.926$, $p = 0.054$; see the first column of Table 2). Importantly, the interaction term picks up the effect of a one-unit increase in negativity when time is one second (given that we control for the logarithm of time, where a logarithm of 0 equals 1). Moreover, when inspecting the average time series (Figure 2) of corrugator activity per story, the negative videos elicited greater corrugator activity compared to positive activity. This confirms there is a main effect of negativity on corrugator activity. A more simplified model—which we did not preregister—in which the interaction between corrugator activity and time is excluded produces a positive and statistically significant main effect of negativity on the corrugator ($\beta = 0.060$, $t = 13.569$, $p < 0.001$; see the second column of Table 2). This means that once negativity increases, corrugator activity increases. The standardised effect is small but

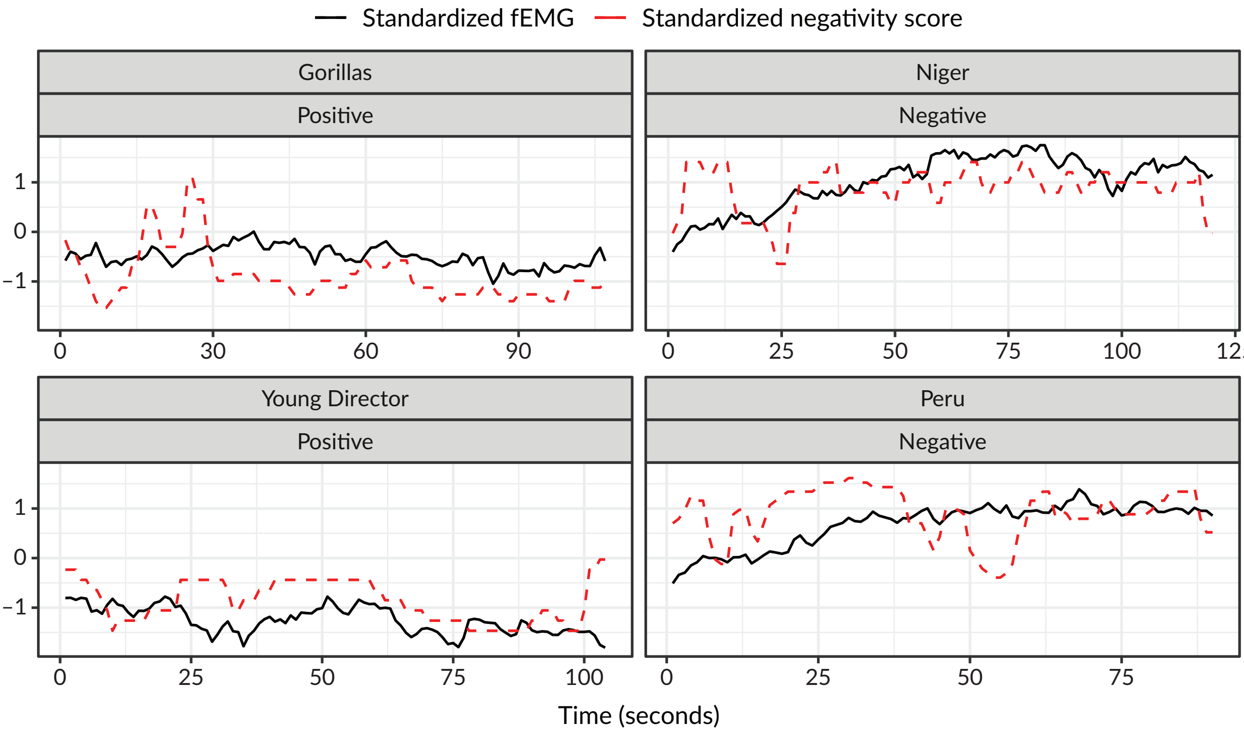


**Figure 2.** Average corrugator (fEMG) activity from time series per story. Notes: The black line projects the $z$-standardised mean corrugator (fEMG) activity over the seconds (x-axis) per video treatment (panel); the red line plots the $z$-standardised tone of the video; the negativity score ranges from negative (positive values on the y-axis) to positive (negative values on the y-axis).

**Table 2.** Effect of negativity on standardised change in fEMG.

| | Standardised change in fEMG | |
|---|---|---|
| | Preregistered model | Exploratory model |
| Time (seconds, logged) | 0.005<br>(0.006) | 0.005<br>(0.006) |
| Time × Negativity | 0.006<br>(0.005) | |
| Lagged fEMG | −0.004***<br>(0.0001) | −0.004***<br>(0.0001) |
| Order | −0.004<br>(0.005) | −0.004<br>(0.005) |
| Negativity | 0.038*<br>(0.019) | 0.060***<br>(0.004) |
| Observations | 37,844 | 37,844 |
| $R^2$ | 0.030 | 0.030 |
| Adjusted $R^2$ | 0.028 | 0.028 |
| $F$ statistic | 235,679*** | 294.249*** |

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

larger than SFN's SCL effect and in line with other studies that rely upon the corrugator. Taken together we accept H2: Negative news increases corrugator activity.

### *3.3. Extensions Using Self-Reported Measures of Arousal (H3) and Valence (H4)*

Finally, we hypothesised that the cognitive counterparts of our physiological measures would be affected in the same manner: Negative news compared to positive news would be perceived as both more negatively valenced and arousing. Both arousal and valence were measured using the manikins on a nine-point scale, in which 1 indicates *very positive* or *no arousal* and 9 indicates *very negative* or *very arousing*. Instead of discussing the outcomes of the preregistered fixed-effects models (see pre-analysis plan on OSF), Welch's two-sample $t$-tests will be discussed. These were performed with base R (Version 4.3.0; R Core Team, 2023). The Welch's variant was used given that the variances differ significantly across conditions. The interpretations do not change when relying on the preregistered models—Results can be derived from the replication files.

Negative news is indeed perceived as more negatively valenced ($M = 7.55$, $SD = 1.15$) compared to positive news ($M = 2.66$, $SD = 1.49$), $t = 36.013$, $p < 0.001$. This is in line with our preregistered hypothesis. Figure 3 visualises this pattern by showing the aggregate perceived valence per story. This indicates that the negative videos are rated much higher compared to the positive ones. This pattern replicates the findings for tone that SFN reported.

Contrary to our expectations, it is positive news ($M = 6.45$, $SD = 2.17$) instead of negative news ($M = 4.76$, $SD = 1.80$) which is perceived as more arousing, with $t = -8.28$ and $p < 0.001$. This pattern can also be deduced when inspecting the aggregates per story (Figure 3), highlighting that the centrality measures (the mean and median) are consistently higher for the positive videos compared to the negative videos. This is in line with Ravaja et al. (2015), who also found that positive news was perceived to be slightly more arousing as compared to negative news.

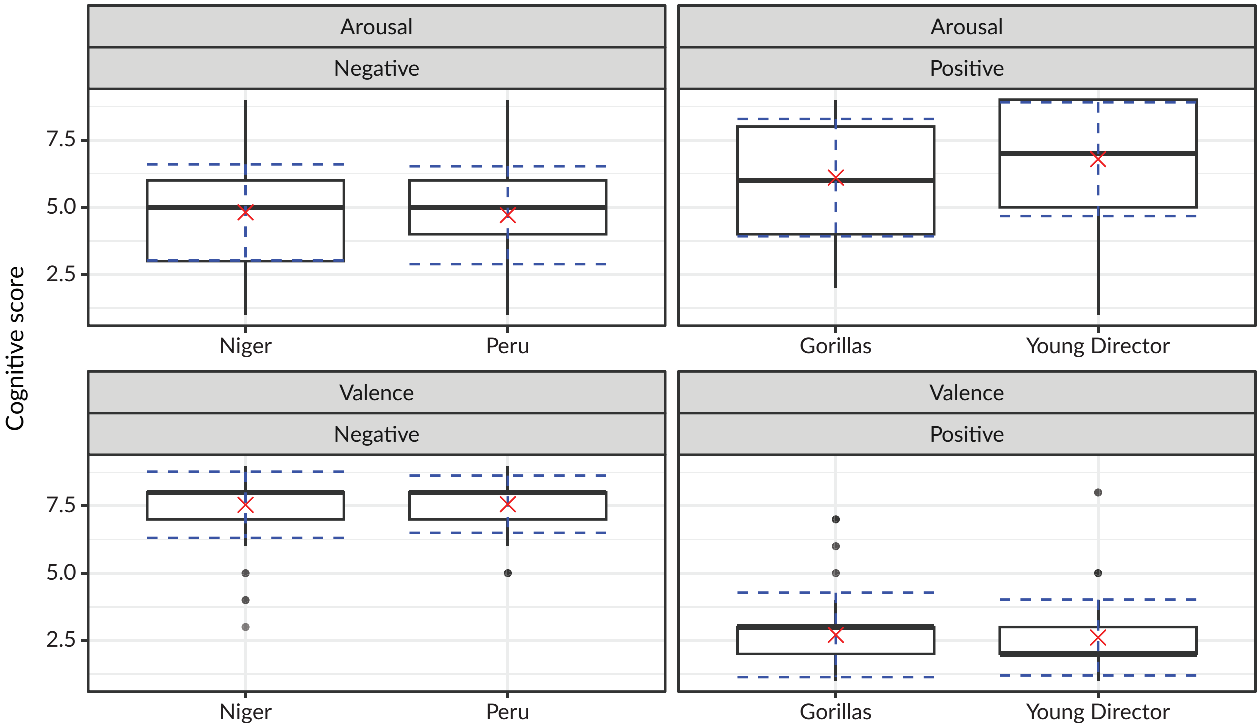


**Figure 3.** Valence and arousal in response to negative and positive news clips. Notes: The black lines depict the distribution via a boxplot; the red cross represents the mean; the blue dotted lines indicate the standard deviation from the mean; the top panel projects the self-reported arousal, from *low* (1) to *high* (9) in response to negative clips (left-hand panel) and positive clips (right-hand panel); the bottom panel projects self-reported valence, from *positive* (1) to *negative* (9) in response to negative clips (left-hand panel) and positive clips (right-hand panel)

### 3.4. Exploring the Alignment Between Physiological and Self-Reported Responses to News

Self-reported valence and the physiological measure of valence produce the same conclusions, while the results for arousal are mixed. Yet, there is ongoing discussion about the extent to which physiological responses and self-reported measures should, or should not, align in psychology and neuroscience (for a discussion and illustration, see Arceneaux et al., in press). Therefore, we explore to what extent these two measures correlate (note that this was not preregistered). If corrugator activity (SCL) and self-reported valence (arousal) are weakly correlated with each other, then this provides evidence that (political) communication evokes effects at the more conscious (self-reports) and unconscious (physiology) levels which are relatively independent of each other (Bakker, Schumacher, & Rooduijn, 2021). Yet, if the cognitive self-reported measure of valence (arousal) is strongly correlated with its physiological counterpart, then it might provide an argument to move away from using fEMG to measure valence, as it is a more costly and time-consuming task.

Starting with the correlation between the average physiological arousal, as measured through nSCL activity (mean per clip) and self-reported arousal (in response to the clip), it is practically absent and not statistically significant, $\rho(381) = 0.03$, $p = 0.482$. Thus, this suggests that these measurements capture different aspects of the affective experience. When we correlate the average fEMG per story with the perceived valence of the story, the correlation is statistically significant but not very strong, $\rho(357) = 0.35$, $p < 0.001$.

Our take-home message from this correlation is that fEMG and self-reported valence pick up different aspects of the affective experience but the results are pointing in the same direction. At the same time, we acknowledge that this test is not perfect: Physiological measures are measured continuously while the self-reports are only measured after each clip. In an ideal world, our self-reported measures of valence and arousal would have been collected at a higher interval level but (a) this would deviate substantially from SFN's design and (b) we did not think about this option in the design stage.

## 4. Discussion

This study replicates and extends the foundational work by SFN in four ways. First, negative news seems arousing, as captured in changes using SCLs. The effect seems to fall within the bounds of SFN but it remains to be seen if it is a substantively meaningful effect as it might not differ from 0. Second, we extend SFN by showing that negative news is causing negative affect as captured with corrugator activity and self-reported negative affect. Third, we find no evidence that negative news causes increases in self-reported arousal; in fact, we find that positive news is more arousing. Fourth, our replication adds the 18th country (the Netherlands) in which the negativity bias is studied. In what follows, we discuss the implications of our findings for political communication research on the negativity bias and reflect on the importance of replication studies in empirical (political) communication research.

We acknowledge that our result for SCL is in the expected positive direction but not statistically significant, a lot smaller than the estimate of SFN and depending on the chosen bounds of the equivalent test, suggests our result may or may not be negligible. For some readers, this might be a reason to interpret our findings as being a "failed replication" of SFN. But, following Gelman and Stern (2006), we also assessed whether our results differ from those of SFN. Exploratory tests hint at the fact that our result is not different from SFN's pooled results across 17 countries. Moreover, close inspection of the results per country in SFN's study also demonstrates that, in nine out of the 17 countries, the effect was statistically significant, while this was not the case in the other eight countries. To summarise, our results for SCL should be seen as in line with SFN's results. Pooling our results with those of SFN, we got one step closer to the population-based effect size of negative news on physiological arousal as captured with skin conductance. It is a small but positive effect.

Our work has implications for the negativity bias argument in political communication: We need to move away from the focus on (physiological) arousal. SFN limited their theorising and tests of the negativity bias to one dimension of affect, arousal measured with skin conductance. Yet, affect consists of at least two (some argue three or more) dimensions (Russell, 1980; Schiller et al., 2022). We extended SFN's argument and turned to valence as the second dimension of affect. Building upon SFN's logic, we hypothesised and confirmed that negative news increases negative valence as captured with the activity of the corrugator muscle. Our work thereby refines SFN's theory and shows that negative news causes negative affect. Thereby, we align the negativity bias theory better with developments in psychology and neuroscience that discuss the importance of studying multiple dimensions of affect (Schiller et al., 2022).

Our work also has important societal implications. The prolonged experience of negative affect in response to news could negatively affect both mental (Ford & Feinberg, 2020) and political health (Smith et al., 2023). Moreover, negative affect could cause news fatigue and ultimately the avoidance of news altogether (de Bruin et al., 2021), which could have detrimental negative consequences for democracy (Blekesaune et al., 2012). Therefore, it is important to understand the affective responses people experience in response to the news.

We identify multiple options for future research. First, the features of the study design could be improved. SFN manipulated the valence of the stimuli but not arousal. As a reviewer pointed out, it might be worth it to manipulate arousal *independent* of valence to see if more arousing content indeed causes arousal. This would help to determine the exact boundaries of the negativity bias argument. Related to this, future research might also want to establish the equivalence of different treatments that are negative (and positive) to avoid stimuli-specific confounds driving the effects. A more dynamic modelling approach with attention to events in the treatment could be useful (e.g., Schumacher et al., 2022), but, ideally, this equivalence is achieved in the design stage by careful pilot testing and validation of materials. Second, we have studied the effects of negativity bias, while negativity bias might actually be the cause of political information consumption. Stylised experiments outside of the domain of political communication (New et al., 2007; Nissens et al., 2017) could lead to the hypothesis that negative news, just like moral content (Gantman & Van Bavel, 2014), captures more attention. Designs that allow participants to select in (or out) of negative (vs. positive) news might show that some people are more affected by negative news than others (for inspiration of such designs, see Arceneaux et al., 2013). Third, scholars could take inspiration from work in constructive and solution-based journalism, which have been proposed as ways of covering both negative and positive valenced news in a "better" way. We could envision future research that manipulates these and other forms of journalism to see if negative affect (and positive affect) are stronger or weaker depending on the way negative (or positive) news is covered.

Our study, like any other, comes with some limitations. First, our study was a pretty close replication of SFN, but we used, for instance, different equipment, slightly different procedures, and added a new context. Do these differences affect the results? Here we reflect on some of these concerns. First, does it matter that we conducted our study in the Netherlands? No, this is unlikely. SFN found little indication that country characteristics explained variation in the negativity bias, thereby addressing concerns that the negativity bias is conditional upon context (e.g., Van Bavel et al., 2016). Second, does the specific place where we conducted the study matter? No, this is unlikely. Our lab has, like any lab, a unique physical makeup. A recent evaluation of data collected at different locations (a university lab and different lab-in-the-field settings) showed that the results were robust across contexts (Schumacher et al., 2024). Third, does the equipment matter? No, this is unlikely. We used different equipment than SFN. At the same time, we think it is unlikely that the equipment would cause any differences in the results. Our equipment has been used in the past, by other teams, to successfully capture skin conductance and fEMG activity (Gazendam et al., 2013; Nohlen et al., 2016; Sevenster et al., 2015). Fourth, does the type of physiological measures used affect the results? No, this is unlikely. SFN measured SCL and heart rate variability which are relatively unobtrusive measures. We turned to corrugator activity and had to connect wires to a participant's face. We think it is unlikely that our SCL results are affected by the use of the corrugator measure. Moreover, we think our corrugator measure is valid as we (a) do not tell people about the purpose of the measure and (b) in other studies we have successfully shown to measure corrugator activity in response to political and non-political stimuli (e.g., Bakker, Schumacher, & Rooduijn, 2021; Homan et al., 2023). Last, could the effects of the stimuli have become weaker over time? No, this is unlikely. The stimuli from SFN are a few years old; Soroka (personal communication, October 30, 2023) indicated that they are from the period 2015–2016. One could argue that the stimuli became less powerful because, for instance, journalistic reporting changes over time and the world might have become more negative. We think this is unlikely as our results for valence are consistent across physiological and self-reported measures. A second concern regarding the selection of stimuli is that we used only two negative and two positive clips. As discussed, we did this because our omnibus study had limited space for this replication project. Yet, if the results would hinge on the exact number of stimuli, then the negativity bias is not a robust effect. Therefore, we think this is unlikely to bias our results. To summarise, we disregard these limitations. At the same time, we are the first to acknowledge that similar procedures and equipment are desired when doing close replications. Yet, it is important to remember that if the negativity bias is a robust finding then the small differences between study designs discussed here should not affect the results.

Where should we go from here when it comes to doing replication studies in (political) communication research? We have four concrete recommendations. Recommendation 1: Following Nuijten et al. (2018), we reanalysed and reproduced SFN's results at the start of the study. It allowed us to get the effect size (standardised SCL effect) and showed that the results were robust to the modelling specification we proposed. Recommendation 2: Following King (1995), we directly replicated SFN's central finding and extended it. In doing so, we assess the replicability of the finding (Freese & Peterson, 2017) and generate new knowledge (i.e., negative news also causes negative affect). Recommendation 3: To verify the results (see recommendation 1) and directly replicate SFN (see recommendation 2), we needed open data and materials. We were pleased that SFN provided their data publicly and were able to share the stimuli with us. This illustrates the point made by Bowman and Spence (2020) about the importance of open data and materials. Recommendation 4: We need academics like Soroka with a welcoming mindset to replication. Soroka has been responsive to our questions throughout the project and, most of all, has encouraged us to pursue this replication project. We recommend scholars take Soroka's mindset as an example of how to "deal" with scholars who want to replicate and extend their work.

For those interested in physiological responses to political communication, we have one specific suggestion: Let us collaborate more. Laboratory studies are time intensive (it takes months to complete a study), they are costly to start (lab equipment, lab space) and they are costly for participants (one participant per hour). As a consequence, samples are often small (too small to be sufficiently powered), and novelty is privileged over replications. Like Chambers (2017), we think replications should, however, be part of the cycle through which we generate knowledge. Therefore, we urge scholars to make replications standard practice. It is tempting, also for us, to continue to function as moles (University Library Vrije Universiteit Amsterdam, 2018): Each mole (a researcher or team of researchers) digs its own tunnel and generates its own body of research. Yet, the tunnels of different moles are not in contact with each other. Thereby we are not accumulating knowledge across research teams and are not getting closer to understanding the robustness and replicability of the phenomena of interest (Chambers, 2017). Instead, Rene Bekkers (University Library Vrije Universiteit Amsterdam, 2018) suggests that scientists could take inspiration from ants: They work together and get a lot done in close cooperation. We encourage multi-laboratory collaborations where scholars free up space in their protocol for others to test their ideas. Scholars with more resources could especially consider providing space in their protocols to junior scholars and minority researchers. This could be considered an "act of solidarity" (Lukito, 2024) by those with more resources. Our lab is open to this opportunity and we encourage interested readers to contact us.

We hope close replications become standard in empirical (political) communication research. Yes, we are aware that replication studies are still relatively uncommon in quantitative communication research (Bakker, Jaidka, et al., 2021; Keating & Totzkay, 2019; McEwan et al., 2018). At the same time, communication researchers hold positive attitudes towards replication studies and say that replications improve the discipline (Bakker, Jaidka, et al., 2021; Bowman et al., 2022). Thematic issues, like this one, are ways to stimulate replication studies. Yet, real change happens when more people start doing replication studies and when editors, reviewers, grant committees, and hiring committees become more welcoming to them. This requires structural change. At the same time, this does not excuse individual researchers from trying to change the system. Replications only become more common if more people start doing them. Therefore, we hope that our study stimulates others to also engage in replication studies.

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## Conflict of Interests

The authors declare no conflict of interests.

## Data Availability

The data is publicly available online at: https://osf.io/jwszx. The code to reproduce our results can also be found on this OSF page.

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