Emotional news affects information processing and social judgments independent of perceived media credibility

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Abstract

How does the credibility we attribute to media sources influence our opinions and judgments derived from news? Participants read headlines about the social behavior of depicted unfamiliar persons from websites of trusted or distrusted well-known German news media. As a consequence, persons paired with negative or positive headlines were judged more negative or positive than persons associated with neutral information independent of source credibility. Likewise, electrophysiological signatures of slow and controlled evaluative brain activity revealed a dominant influence of emotional headline contents regardless of credibility. Modulations of earlier brain responses associated with arousal and reflexive emotional processing show an effect of negative news and suggest that distrusted sources may even enhance the impact of negative headlines. These findings demonstrate that even though we acknowledge source credibility, information processing and social judgments rely on the emotional content of headlines, even when they stem from sources we distrust.

Key words: news media, media trust, emotional person knowledge, social judgments, event-related brain potentials

In times of massive online communication, news and information from various sources spreads rapidly, shaping personal opinions as well as public debates (Vosoughi, Roy, & Aral, 2018). Aside from well-vetted news, intentionally or unintentionally spread misinformation, "fake news" and "alternative facts" have gained influence (Lazer et al., 2019). Despite the potentially detrimental effects of misinformation and their increasing prevalence in (social) media and political discourse, research on the consequences of being exposed to misinformation is scant, and little is known about the behavioral and neural correlates of processing information of questionable veracity (Baum, Rabovsky, Rose, & Abdel Rahman, 2018). Experimental evidence revealing insights into the cognitive mechanisms can be vital to a comprehensive understanding of how we are affected by information from media (as argued, e.g., by Aral & Eckles, 2019; Lazer et al., 2018; and Vosoughi et al., 2018).

One resource-efficient and fast heuristic to assess the veracity of news is to consider the credibility of the source. Indeed, recent evidence suggests that we trust or distrust media sources based on criteria as familiarity, likability, social endorsement and reputation, and laypeople's credibility assessments align with those of professional fact checkers (Metzger & Flanagin, 2013, Pennycook & Rand, 2018; Pennycook & Rand, 2019). However, despite our ability to evaluate the credibility of a source, little is known about the impact of such assessments on the cognitive processes underlying social judgments and decisions. Here we investigated with a well-controlled experimental design the consequences of being exposed to news from various sources. Specifically, we asked how the perceived credibility of existing and well-known news sources affects information processing and social judgments based on person-related negative or positive headlines. We extracted event-related brain potentials (ERPs) from the electroencephalogram (EEG) to localize the effects and interactions of social-emotional information and source credibility at early reflexive and later more controlled processing stages to gain insight into the underlying cognitive mechanisms and brain signatures.

We exposed participants to experimental but authentic website versions of existing and widely distributed well-known German news media (e.g., *tagesschau.de* or *bild.de;* cf. Fig. 1a, Phase 1) that were selected based on their pre-rated high or poor credibility. Each website presented the portrait of an unfamiliar person along with affective person-related information in the form of a negative, positive or neutral headline, using original fonts and layouts (see Fig. 1a, Phase 1; SI Table S23 for all headlines). To enhance authenticity we added news reports about well-known persons as fillers. The assignment of unfamiliar faces

to conditions was counterbalanced: while one participant was exposed to each face only in one context condition, the faces were presented equally often in each condition across participants. To check whether the news exposure manipulation was successful, we subsequently tested whether the faces were reliably recognized and how likable participants found each person before and after news exposure (Fig. 1b, Phase 1). An additional manipulation check with different participants used eye tracking to verify that the source information was sampled from the websites (Fig. 1a, Phase 1).

The main experimental task followed in Phase 2, in which the faces were presented in isolation and the EEG was registered while participants judged the depicted persons based on the information they had been exposed to (social judgment, cf. Fig. 1, Phase 2). Just as it is typically the case when reading news headlines, participants were not explicitly instructed to consider the credibility of the source. Instead, they were asked to take all available information into account for their judgment, which should also include the source of the information. After the main task participants rated the familiarity, likability and credibility of the news media sources as an additional manipulation check (Fig. 1, Phase 3).

What are the expected consequences of having been exposed to emotional news from trusted and distrusted sources on social judgments? The family of dual-process theories distinguishes between two separate systems or interactive processes related to fast, impulsive, spontaneous and automatic processing on the one hand, and slower intentional and controlled processing on the other (e.g. Cunningham & Zelazo, 2007; Gawronski & Bodenhausen, 2006; Kahneman, 2003; Lieberman, 2007; Strack & Deutsch, 2004). This suggests that initially our cognitive system spontaneously processes the emotional content of the headlines associated with the person irrespective of the credibility of the source, whereas later, more controlled processes should result in evaluations that take the credibility of the source into account, resulting in social judgments that are qualified according to the presumed credibility.

With respect to emotion processing, appraisal theories (Ellsworth & Scherer, 2003; Scherer, 2001) assume that stimuli are initially checked for a coarse detection of emotional salience, intrinsic pleasantness and arousal. This is followed by assessments regarding implications for the observer's well-being, coping possibilities, and evaluations of the normative significance, like the compatibility with moral standards. This may also include the truth value of information. Concerning the impact of news, and in analogy to dual process theories, emotional contents and source credibility should be processed at different points in time. While early emotional responses should be influenced only by the emotional content of headlines, later more controlled processes should take source credibility into account.

Fig. 1: News exposure and manipulation checks before and after the main task.

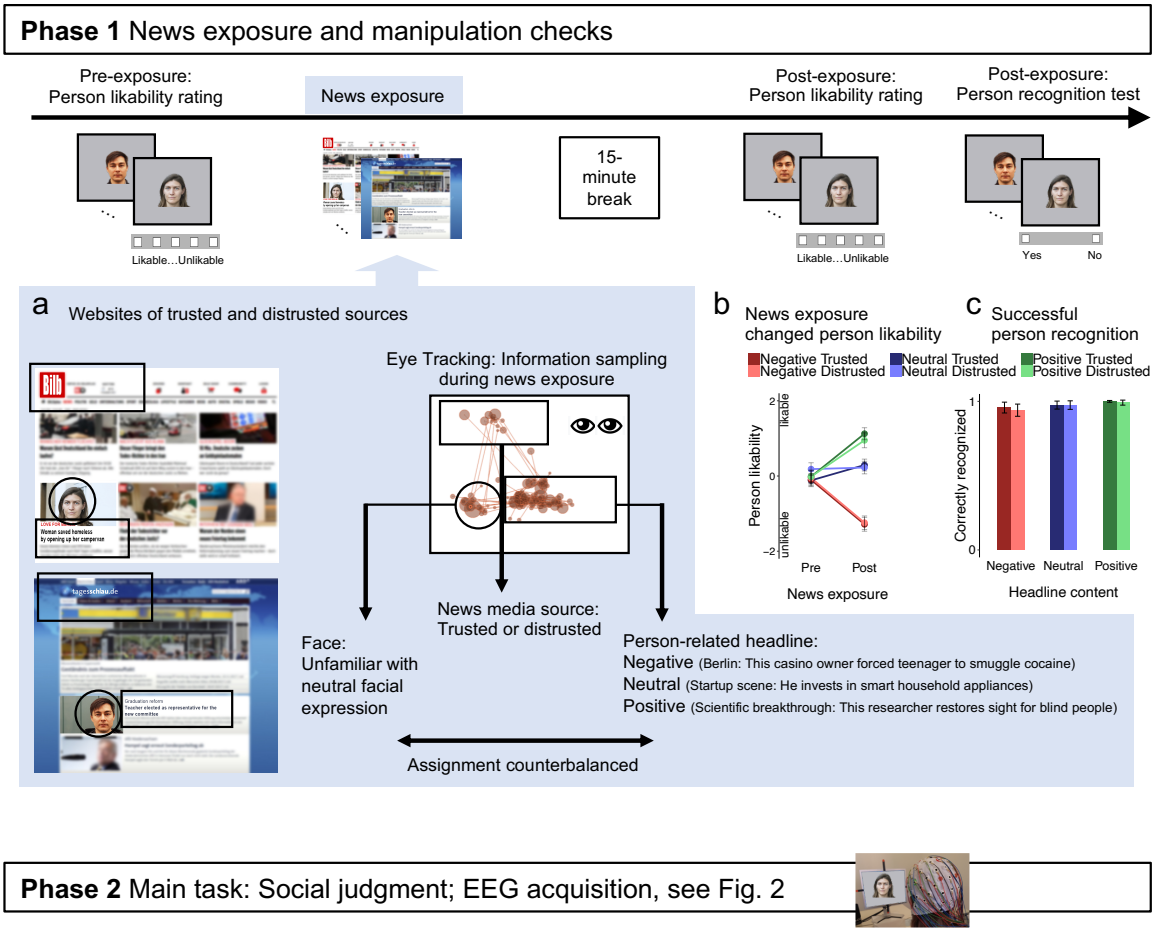

Fig. 1. **a**, In **Phase 1** participants were exposed to news via websites of trusted and distrusted sources that contained the news media source logo, the face, and the headline with all other details blurred (in the experiment original layouts, logos and fonts were used). An additional eye tracking experiment with different participants verified the sampling of source information during news exposure (shown here: example data of one participant for one website, lines represent saccades, points represent fixations and point magnitude their duration). **b**, **c**, Pre- and post-exposure person likability ratings and a post-exposure person recognition test served as manipulation checks. In **Phase 2** the EEG was acquired while a social judgment task was employed as the main task (see Fig. 2). **d**, **Phase 3** entailed manipulation checks of the media sources confirming that they were differentiated in trustworthiness and likability. In **b**, **c**, **d** error bars represent 95% confidence intervals.

In ERPs fast and early processing has been related to an enhanced early posterior negativity (EPN) at about 200 – 300ms at occipito-temporal brain regions that indexes reflexive and arousal-related emotional processes (e.g., Junghöfer, Bradley, Elbert, & Lang, 2001; Kissler, Herbert, Peyk, & Junghöfer, 2007; Schupp, Junghöfer, Weike, & Hamm, 2003; Schupp et al., 2004). At later stages an enhanced late positive potential (LPP) at about 400 – 600ms at centro-parietal regions is associated with elaborate and reflective processing (Sabatinelli, Keil, Frank, & Lang, 2013; Schacht & Sommer, 2009a; Schupp et al., 2004). Both components are sensitive to affective person-related information associated with faces (for instance, EPN: Luo, Wang, Dzhelyova, Huang, & Mo, 2016; Suess, Rabovsky, & Abdel Rahman, 2015; Wieser et al., 2014; Xu, Li, Diao, Fan, & Yang, 2016; LPP: Abdel Rahman, 2011; Baum et al., 2018; Luo et al., 2016). Crucially, the LPP is sensitive to additional information such as context and relevance, putting emotional contents into perspective (Herbert et al., 2011; 2013; Rellecke, Sommer, & Schacht, 2012; Schacht & Sommer, 2009b; Schindler, Vormbrock, & Kissler, 2019), whereas the EPN is relatively independent of task demands and the relevance of emotional contents in a given context (C. Herbert, Pauli, & Herbert, 2011; Herbert, Sfärlea, & Blumenthal, 2013; Schacht & Sommer, 2009b). We therefore expected that the EPN is mainly sensitive to the emotional content of the headlines irrespective of source credibility, whereas emotion effects in LPP amplitudes should be modulated by source credibility, with reduced amplitudes for distrusted sources.

To summarize, based on dual-process theories distinguishing fast impulsive and slower more controlled processes, we expected that early processing of faces associated with emotional vs. neutral headlines from trusted and distrusted sources should be modulated only by effects of emotion, whereas later controlled evaluation should take source credibility into account, resulting in tempered social judgments. The present study was preregistered under the OSF (Baum & Abdel Rahman, 2018[1]).

Results

To investigate the consequences of news exposure, we examined effects of emotion and their modulation by source credibility on social judgments. To this end we used mixed effects models with the factors headline content (negative minus neutral, positive minus neutral), source credibility (trusted minus distrusted) and their interactions.

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[1] Preregistrations will be published upon peer-reviewed publication.

Effects of Emotional News on Information Processing and Social Judgments (Phase 2)

Behavioral Results.

Persons associated with negative relative to neutral headlines were judged as more negative (b = -1.90, 95% CI [-2.09, -1.70], t = -15.98, p < .001) and persons associated with positive headlines were judged more positive (b = 1.17, 95% CI [.98, 1.37], t = 10.01, p < .001). Source credibility had no influence on social judgments (b = .02, 95% CI [-.07, .10], t = .31, p = .761) and there was no interaction between headline content and source credibility (b = -.02, 95% CI [-.26, .22], t = -.13, p = .897 for negative headlines, with effects for trusted b = -1.91, 95% CI [-2.11, -1.70], t = -15.45, p < .001, and for distrusted sources, b = -1.89, 95% CI [-2.14, -1.63], t = -12.27, p < .001; and b = -.02, 95% CI [-.21, .16], t = -.22, p = .826 for positive headlines, with effects for trusted, b = 1.16, 95% CI [.94, 1.38], t = 8.63, p < .001, and for distrusted sources, b = 1.19, 95% CI [.98, 1.39], t = 9.49, p < .001). See Fig. 2b and SI Tables S1, S2.

Post-hoc, we included repetition as a covariate to test whether social judgments were biased towards focusing on emotional contents by repeating the task, which was necessary to ensure EEG data quality. The three-way interactions were not significant (all *ts* < |.9|, all *ps* > .4; see SI Table S3 for judgments and S6 for reaction times). Moreover, testing only the first judgments per face (task was repeated block wise) resulted in the same pattern (see SI Table S4 for judgments and S7 for reaction times). We conclude that repetition did not change the result pattern.

Social judgments related to negative and positive compared to neutral headlines were faster (with reciprocal transformed latencies (-1000/latency in (ms)): b = -.13, 95% CI [-.17, -.08], t = -4.69, p < .001 for the negative, and b = -.06, 95% CI [-.09, -.03], t = -3.04, p = .007 for the positive condition). In contrast, source credibility did not influence the speed of social judgments (b = -.01, 95% CI [-.01, .03], t = .84, p = .410) and there was no interaction between headline and source credibility (b = -.02, 95% CI [-.07, .03], t = -.65, p = .521 for negative headlines, with effects for trusted, b = -.14, 95% CI [-.19, -.09], t = -4.39, p < .001, and distrusted sources, b = -.12, 95% CI [-.17, -.07], t = -3.74, p = .001; and b = -.02, 95% CI [-.07, .04], t = -.55, p = .583 for positive headlines, with effects for trusted, b = -.07, 95% CI [-.11, -.03], t = -2.71, p = .008, and distrusted sources, b = -.05, 95% CI [-.09, -.01], t = -2.00, p = .049). See Fig. 2b and SI Tables S1, S5.

Electrophysiological Brain Responses.

To investigate relatively fast and reflexive emotional processing we focused the EPN component. In the EPN ROI and time window, negative compared to neutral headlines elicited an enhanced negativity (b = -.29, 95% CI [-.47, -.11], t = -2.65, p = .014) and there was a trend for an interaction between headline and source credibility (b = .42, 95% CI [.08, .77], t = 2.00, p = .056) that was due to an enhanced EPN effect for distrusted sources (b = -.50, 95% CI [-.75, -.25], t = -3.3, p = .002), which was absent for trusted sources (b = -.08, 95% CI [-.33, .17], t = -.52, p = .61). In contrast, there was no difference between positive and neutral headlines (b = -.11, 95% CI [-.29, .06], t = -1.09, p = .287), no main effect of source credibility (b = -.02, 95% CI [-.20, .15], t = -.23, p = .819) and no interaction between positive headlines and source credibility (b = .14, 95% CI [-.25, .53], t = .59, p = .559, with no effects for trusted, b = -.04, 95% CI [-.30, .22], t = -.27, p = .786, and for distrusted sources, b = -.18, 95% CI [-.45, .08], t = -1.16, p = .250). See Fig. 2c and SI Tables S8, S9.

To investigate more controlled evaluative processing, we tested effects in the later LPP component. Compared to neutral headlines, negative headlines elicited an enhanced LPP (b = 1.13, 95% CI [.85, 1.40], $t = 6.79$, $p < .001$). The interaction between headline and source credibility was not significant (b = .36, 95% CI [.01, .71], $t = 1.69$, $p = .10$), and negative information from both, trusted and distrusted media sources elicited LPP effects (b = 1.31, 95% CI [.98, 1.63], $t = 6.62$, $p < .001$ for and b = .95, 95% CI [.62, 1.27], $t = 4.79$, $p < .001$ respectively). Positive compared to neutral headlines also elicited an enhanced LPP (b = .50, 95% CI [.27, .72], $t = 3.60$, $p = .001$), and this effect did not interact with source credibility (b = .21, 95% CI [-.21, .63], $t = .83$, $p = .414$), and positive information from both, trusted and distrusted media sources elicited LPP effects (b = .60, 95% CI [.29, .91], $t = 3.20$, $p = .002$ for and b = .39, 95% CI [.08, .70], $t = 2.07$, $p = .043$, respectively). There was no main effect of source credibility (b = .10, 95% CI [-.07, .28], $t = .95$, $p = .353$). See Fig. 2d and SI Tables S10, S11.

Fig. 2: **Phase 2** Main task: Social judgment; behavioral and EEG results.

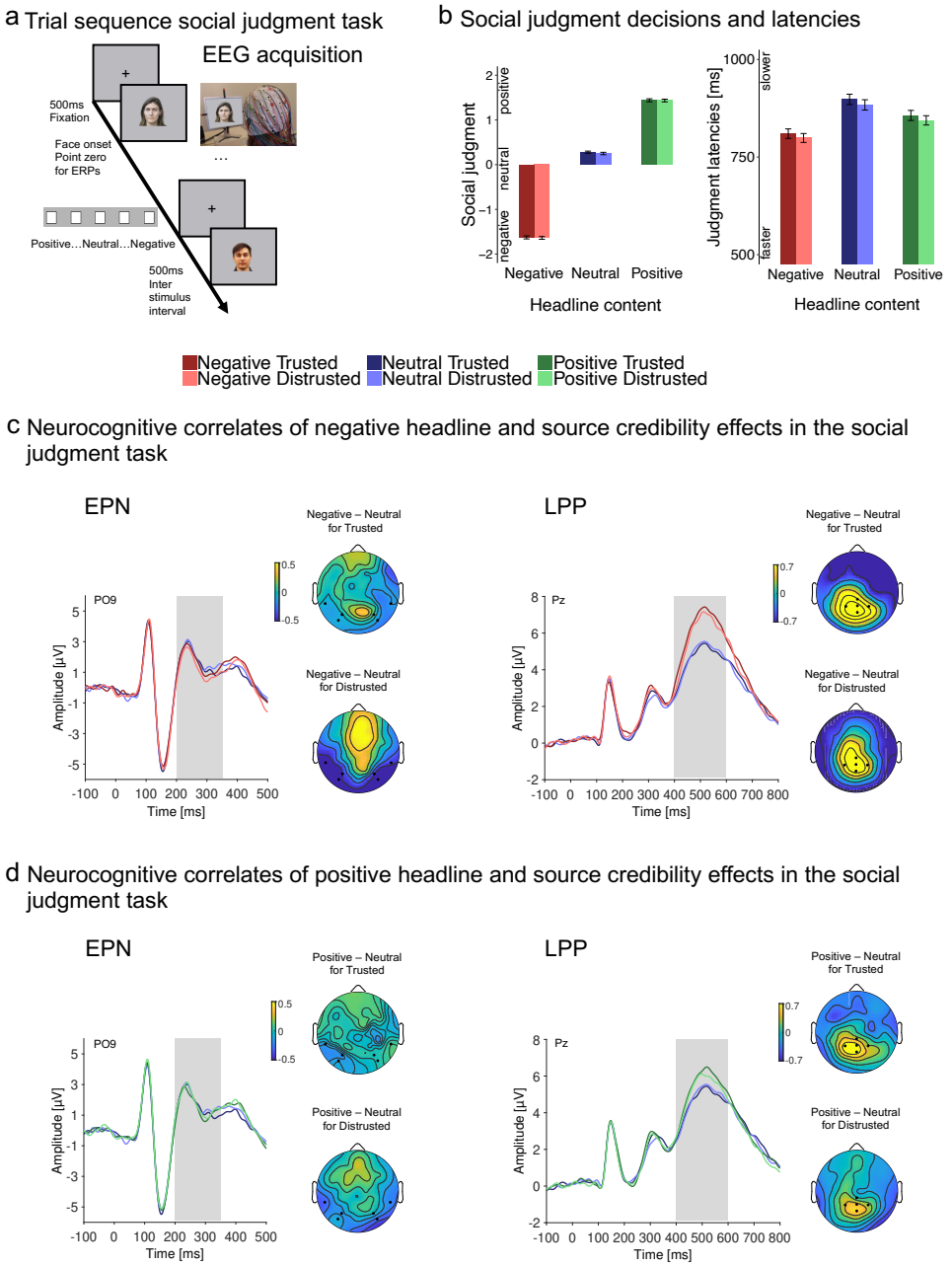

Fig. 2. In **Phase 2** the EEG was acquired while a social judgment was performed to investigate the effects of emotional news and source credibility. **a**, ERP time point zero was the face onset on the screen and participants' task was to judge the person based on all available information on a 5-point scale from positive to negative. **b**, Behavioral results show that persons were judged based on emotional headline content, whereas source credibility had no influence. Judgments based on emotional headlines were faster than neutral, but not tempered by source credibility. Error bars represent 95% confidence intervals. **c**, ERP results for persons related to negative headline content reveal that reflexive emotional processing in the EPN (200–350ms) was affected by headline content.. Evaluative processing in the LPP (400–600ms) was enhanced for negative headlines from trusted as well as distrusted sources. **d**, For persons related to positive headlines no EPN (200–350ms) modulation was observed, and the LPP (400–600ms) was enhanced for positive headlines from trusted and distrusted sources. In **c**, **d**, grand average ERPs are shown for the EPN at electrode sites PO9 and for the LPP at Pz, and scalp distributions show the effects as differences between conditions in the respective time windows shaded in grey.

News Exposure and Manipulation Checks (Phase 1)

We manipulated headline content and news media credibility during news exposure and demonstrate that these manipulations were successful. Pre-exposure person likability ratings were on average neutral (all *ts* < |1.97|, all *ps* > .05), whereas participants liked persons less that were associated with negative compared to neutral headlines (b = -1.52, 95% CI [-1.70, -1.34], t = -13.96, p < .001), and they liked persons more that were associated with positive compared to neutral headlines (b = .78, 95% CI [.64, .92], t = 9.01, p < .001) after news exposure. Source credibility did not influence likability ratings (b = .07, 95% CI [-.05, .18], t = .97, p = .339) and there were no interactions between headline content and source credibility (b = -.11, 95% CI [-.36, .14], t = -.71, p = .477 for negative headlines, with effects for trusted, b = -1.57, 95% CI [-1.89, -1.26], t = -8.28, p < .001, and for distrusted, b = -1.47, 95% CI [-1.78, -1.15], t = -7.71, p < .001; and b = .11, 95% CI [-.14, .36], t = .71, p = .477 for positive headlines, with effects for trusted, b = .83, 95% CI [.63, 1.03], t = 6.89, p < .001, and for distrusted, b = .73, 95% CI [.53, .92], t = 5.99, p < .001). See Fig. 1b and SI Tables S16, S17. In the post-exposure recognition test, faces were successfully recognized across conditions, M = 97.3 %. There were no effects of headline or source on accuracy (see Fig. 1c and SI Tables S18, S19).

We also conducted an additional eye tracking experiment with twelve participants who did not take part in the main experiment (mean age = 25 (SD = 7.93), 8 females, all right-handed) to check whether participants acknowledge the media source during news exposure, without having been explicitly instructed (see Procedure). We measured fixation durations and frequencies in the areas where the media source logos were presented (for example see Fig. 1a and for details see SI p. 15). Fixation durations and frequencies within the logo regions were accumulated by face stimulus across the five news report presentations during the exposure phase within participants, and averaged across face stimuli. Filler trials were excluded. One-sample, one-tailed t-tests confirmed that the mean source fixation duration per face (896 ms; 95% CI [440 ms,-]) was above zero, $t(11)$ = 3.53, p = .002, d = 1.02, and that the mean source fixation frequency per face (4.1; 95% CI [2.2,-]) was also above zero, $t(11)$ = 3.93, p = .001, d = 1.14. Furthermore, we tested if the blurred layout without logo by itself provides cues of the media source. After news exposure participants were instructed in a separate task to assign screenshots of websites where the logo had been removed to one of two sources. The forced choice included the logo of the correct media source and a logo of a different source from the other credibility condition. Across faces,

90% of the sources were correctly identified (M = .90, 95%-CI [.86,-], $t(11) = 40.58$, $p < .001$, d = 11.71).

News Media Source Checks (Phase 3)

All participants were familiar with all media sources. Distrusted sources were rated as untrustworthy and less likable, whereas trusted sources were rated as trustworthy and likable (trusted minus distrusted for trust ratings: b = 3.02, 95% CI [2.72, 3.32], $t = 16.64$, $p < .001$, for likability ratings: b= 2.56, 95% CI [2.17, 2.95], $t = 10.80$, $p < .001$). See Fig. 1d and SI Tables S20, S21.

Discussion

Here we show that emotional person-related news headlines strongly affect information processing and social judgments irrespective of whether the source is perceived as credible or not. The emotional content of headlines determined social judgments and affected slow evaluative brain responses in the LPP component known to be sensitive to context information and deliberate control. Crucially, none of these effects was modulated by source credibility, suggesting that headlines in news media may have an even stronger than expected influence on information processing and social judgments. Indeed, even if we assume that there are subtle traces of source credibility modulations that are difficult to detect, the fact remains that headlines from distrusted sources induce strong and robust effects of emotional information on social judgments.

Fast emotional brain modulations in the EPN component associated with arousal and sensation-related reflexive processing were modulated by emotional headline content and show furthermore that, if anything, distrusted sources may even enhance, instead of reduce, the impact of negative compared to neutral headlines. Please note however that this early interaction of headline content and source credibility was not predicted and the interaction was only marginally significant, even though clear and robust emotion effects were found only for distrusted sources. Future evidence should reveal additional evidence on the scope and limits of this effect. We speculate that this influence specifically of negative (but not positive) social-emotional information from distrusted sources may explain in part the popularity and success of (media) sources of questionable credibility: Untrustworthy negative social information may induce not unpleasant states of enhanced arousal or excitation (cf. Menninghaus et al., 2017), increasing the impact of negative information (cf. Kahneman & Tversky, 1979; Zillmann, 2008). Taken together, we conclude that low levels of perceived credibility may, if anything, even enhance the early reception of negative headlines.

The present effects were observed even though participants clearly distinguished between trusted and distrusted sources, as reflected in different measures. First, the perceived credibility of the news sources was determined in a separate rating study, which was confirmed by the participants of the present study, and early emotional responses in the EPN were induced by the logos of media sources judged as untrustworthy relative to trustworthy sources (Phase 3, see SI page 17). Third, active eye movements in an additional manipulation check study demonstrate that the media sources of the headlines are actively acknowledged during news exposure. Finally, we found that even the blurred website layouts without logos provide reliable cues of the source and its credibility. We are therefore confident that the credibility of media sources was successfully manipulated and noticed by the participants.

The pattern of results is in contrast to our theoretical predictions, assuming that fast reflexive processes are mainly based on the emotional contents of the headlines, whereas slower, more controlled evaluations reflected in the LPP component and the actual judgments are modulated by source credibility, putting emotional information of questionable credibility into perspective. In contrast, our findings are in line with recent evidence of strong emotion effects of untrustworthy affective person-related information. In a related study we manipulated the trustworthiness of person-related information with verbal markers such as *supposedly, people assume* etc. (e.g. *He allegedly bullied his trainee*; Baum et al., 2018). Verbal qualifiers have an important communicative and legal function to indicate that the information might not be truthful. Just like in the present study, while participants understood the questionable veracity, person judgments and evaluative brain responses were determined by the emotional information independent of the verbally marked trustworthiness. The similarity of the findings may suggest a general mechanism.

The use of a controlled experimental design with a systematic manipulation of source credibility offers full control of confounding factors such as visual differences between faces, but it also differs in many ways from natural situations. However, here we presented existing and well-known media sources that are stored in long-term memory, including their perceived credibility. This should have even strengthened credibility effects. As in real-life situations when confronted with emotional headlines containing social information, participants in our experiment were not instructed to actively suppress the emotional content or to contemplate about the credibility of the source, but were free to consider source credibility to put their judgments into perspective. In the main task, we asked participants to repeatedly judge the person, which may have induced a strong focus on the news contents and could have distracted from the source. However, post-hoc tests including task repetition

as a covariate and tests including only first judgments did not change the pattern of results, rendering a strong bias towards social judgments, distracting from the sources due to task repetitions as unlikely. We can additionally show with eye tracking that the source of the information is actively acknowledged during news exposure. We would also like to note that judging others based on visual appearance or minimal person-related information seems to be a natural tendency - we spontaneously form impressions about others and draw inferences about their character from minimal information (Bliss-Moreau, Barrett, & Wright, 2008; Foster, 2004; Todorov, Gobbini, Evans & Haxby, 2007; Uhlmann, Pizarro & Diermeier, 2015). We therefore have no reason to assume that the results are due to the experimental situation. Indeed, in a short interview after the experiment (available from 29 participants), 27 expressed no doubt about the authenticity of the media reports. Taken together, our findings complement recent online studies on how true, misleading, or false information spreads and how news and its sources are evaluated (e.g. Brady, Wills, Jost, Tucker, & Van Bavel, 2017; Pennycook & Rand, 2018, Vosoughi et al., 2018) by providing experimental insight into the precise neurocognitive mechanisms that underlie such behavior.

How susceptible is this pattern to minimal cognitive intervention? To test this we replicated the identical experiment with one crucial change (see preregistration Baum & Abdel Rahman, 2019[2] and SI). As a minimal intervention, participants evaluated the media sources regarding familiarity, trustworthiness, and likability before they were exposed to news (Fig. 1, Phase 1). We found a modulation of positive headline effects such that in latencies and in the EPN and LPP component they were only present for trusted, but not for distrusted sources (latencies: b = -.07, 95% CI [-.12, .03], t = -2.52, p = .016 for trusted; b = -.06, 95% CI [-.12, -.00], t = -1.77, p = .083 for distrusted; EPN: b = -.34, 95% CI [-.57, -.10], t = -2.35, p = .022 for trusted; b = -.01, 95% CI [-.25, .22], t = -.08, p = .940 for distrusted; LPP: b = .51, 95% CI [.21, .80], t = 2.83, p = .006 for trusted; b = .24, 95% CI [-.06, .53], t = 1.32, p = .190 for distrusted). In contrast, source effects for negative headlines were not modulated by the prior classification of source trustworthiness (see Fig. 3 and for full description of results please see SI). The results of this additional experiment demonstrate that our emotional responses to news headlines from distrusted sources can be modulated to some degree simply by evaluating the trustworthiness of the media source before being exposed to the information. However, they also show that this holds mainly for positive

[2] Preregistrations will be published upon peer-reviewed publication.

contents, whereas negative information seems to be resistant to the prior classification of source trustworthiness. This differential pattern may be explained by stronger effects of negative information in general, and/or the preferential processing of negative information to prevent potential threat (e.g. Öhman & Mineka, 2001; Baum et al., 2018).

Fig. 3: Replication experiment with classification of source trustworthiness prior to news exposure.
Phase 2 Main task: Social judgment; behavioral and EEG results.

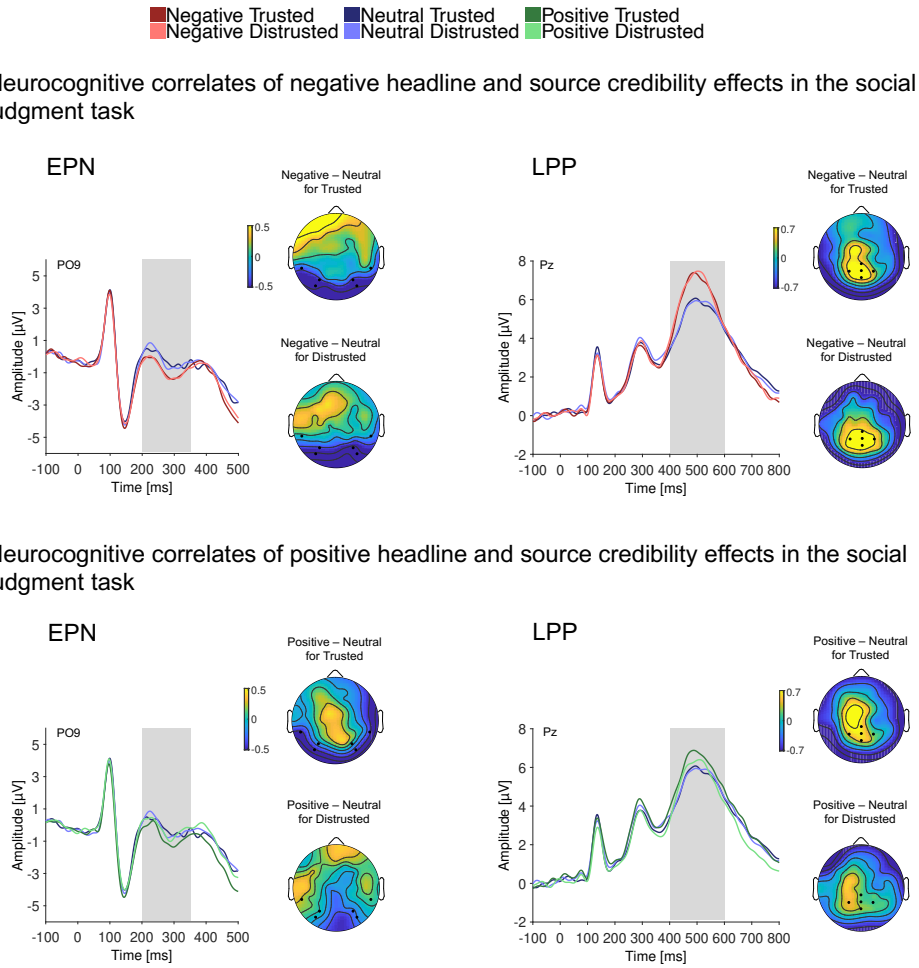

Fig. 3. Replication of the identical experiment except that the media source ratings were conducted before news exposure. In **Phase 2** the EEG was acquired while a social judgment was performed to investigate the effects of emotional news and source credibility (see Fig. 2a). **a**, ERP results for persons related to negative headline content reveal that reflexive emotional processing in the EPN (200–350ms) was affected by headline content. Evaluative processing in the LPP (400–600ms) was enhanced for negative headlines from trusted as well as distrusted sources. **b**, For persons related to positive headlines a EPN (200–350ms) modulation was observed only for trusted sources, and the LPP (400–600ms) was enhanced only for positive headlines from trusted sources. In **a**, **b**, grand average ERPs are shown for the EPN at electrode sites PO9 and for the LPP at Pz, and scalp distributions show the effects as differences between conditions in the respective time windows shaded in grey.

We conclude that the influence of source credibility on the effects of emotional contents of news headlines is remarkably weak. It is conceivable that source credibility did not qualify judgments because participants merely remembered the emotional content of the news but not the source (cf. Johnson, Hashroudi, & Lindsay, 1993) or that they deliberately or unintentionally ignored the credibility of the source. This distinction cannot be made based on the current results and may be targeted in future studies. Another avenue for future research is to explore the role of motivational factors to better understand under which conditions we are more likely to consider source credibility to reduce emotional responses and to put our judgments into perspective (cf. Lewandowsky et al., 2012). Finally, individual differences in perceived credibility, media preference and political orientation may affect the impact of source credibility (cf. Pennycook & Rand, 2018). Future research may further target emotion regulation and enhanced awareness about the consequences of potentially misleading information from sources of questionable credibility as a protection against biased social judgments.

Method

Sample Size

The following power analysis was preregistered on the OSF (Baum & Abdel Rahman, 2018). The sample size was planned according to the counterbalancing of conditions, which requires a multiple of 6 participants, and based on expected coefficients for effects in electrophysiological brain responses (cf. Baum et al., 2018). We ran mixed model simulations (1000 for each coefficient, SIMR package in R, Green & MacLeod, 2016) to estimate the expected power for headline content effects and and interactions with source credibility for a sample of 30 participants. Expected main effects of headline content would be found with 100% power and interactions with source credibility of as small as 0.15µV would be found with over 90% power (EPN: grand mean of -0.4µV, effects of headline content of 0.5µV (power of 100%, 95% CI [99, 100]), interactions with source credibility of 0.15µV (power of 95.50%, 95% CI [94.02, 96.70] for negative vs. neutral headlines, power of 96.30%, 95% CI [94.94, 97.38] for positive vs. neutral headlines) were not expected but estimated in case they already occurred in the EPN; LPP: grand mean of 5µV, effects of headline content of 0.7µV (power of 100%, 95% CI [99, 100]), effect of source credibility of 0.3µV (possible but not expected), interactions with source credibility of 0.15µV (power of 95.50%, 95% CI [94.02,

96.70] for negative vs. neutral headlines, power of 96.30%, 95% CI [94.94, 97.38] for positive vs. neutral headlines).

Participants

Thirty participants (mean age = 25 (*SD* = 5.36), 25 females, all right handed) completed the experiment. One participant was replaced due to being familiar with face databases, two participants were replaced because they rated the trustworthiness equal across all sources, and one participant was replaced because of unsuccessful acquisition of person-related information. Participants were compensated in form of course credit or money. They were (de)briefed about the procedures and signed informed consent. The study was approved by the local ethics committee.

Materials

Websites of news media combined source, face, and headline (for examples see Fig. 1, Phase 1). We digitally edited each colored face photograph onto a natural background (e.g., a street scene, a wall), inserted it onto the website and changed the headline via source code, keeping the characteristic font (with font size kept similar across media sources). Thus we were able to maintain the distinctive layout of the media sources while experimentally manipulating the content, since the layout and visual design of websites plays an important role in assessing the credibility of a source (Metzger et al., 2013). In the experiment, the website screen shots were displayed full screen and showed the prominent logo on the top of the page, the face, and the headline, while all other details were blurred. For the news exposure, 24 unfamiliar faces were equally assigned to neutral, negative and positive headlines, with counterbalanced assignment across participants. The assignment of faces and headlines to media sources was also counterbalanced across participants, with 12 target faces appearing in credible sources and 12 faces in less credible sources, resulting in 4 target faces in each condition of the 3×2 design. Affective information for 8 well-known filler faces referred to recent news about them (e.g. *Will to challenge: She is empowering women* (Emma Watson)), and the assignment of headlines was fixed for all participants.

News media sources were selected based on pre-ratings of credibility and familiarity with a different group of German participants. The pre-rating tested 35 German news media sources, including well-known, less well-known, and highly partisan sources (participants were *N* = 38, 33 females, mean age 26 (*SD* = 4.69), age range 19 – 36, all students). The rating scale was from 3 (very credible) to -3 (not credible). We selected the four sources rated as most credible (*M* = 1.77, 95% CI [1.57, 1.97]), and the four rated as least credible (*M* = -1.64, 95% CI [-1.92, -1.37]), all highly familiar (1 = familiar, 0 = unfamiliar; for credible

sources $M = .98$, 95% CI [0.95, 1], for less credible sources $M = .98$, 95% CI [0.95, 1]). Credibility ratings were significantly higher for credible than for less credible sources, $t(37) = 14.83$, $p < .001$. Colored screen shots of the sources' logos were presented in similar size in the media source ratings of the current experiment (2.7 × 3.5 cm).

Face stimuli were colored frontal portraits of 24 unfamiliar faces with neutral facial expressions, that were presented on a grey background during the main task and manipulation checks (2.7 × 3.5 cm, viewing distance 70 cm; faces were taken from multiple databases, see SI). Eight familiar filler faces (well-known persons, e.g. Emma Watson, Harvey Weinstein) were added to make the target persons' existence credible.

Headlines describing social behavior were either neutral, negative or positive (for all headlines see SI Table S23). Pre-ratings with different participants confirmed their valence and showed that positive and negative headlines were equally more arousing than neutral headlines (see SI p. 19).

Procedure

The procedure entails three phases (Fig. 1) as a variant of a well-established design (cf. Abdel Rahman, 2011; Baum et al., 2018; Suess et al., 2015). In Phase 1, the experiment started with a person likability rating of all face stimuli on a 5-point scale (pre-exposure rating). Response buttons were placed in front of participants. Then the news exposure followed. Participants were told that they receive information taken from media reports about the persons and that unrelated details are blurred. Each trial started showing the website – which was blurred except for the logo of the media source – for one second. For the remaining 5 seconds, the logo, the face and the headline were unblurred. Websites were presented in blocks of 8, including all experimental conditions and 2 fillers. Each websites was presented 5 times in total (160 trials in total). To keep participants engaged with the task, they occasionally answered short yes-or-no questions about the persons, e.g. *Is the behavior of this person common?* (asked in about 22% of the trials of Phase 1). After completion of the news exposure, participants had a 15-minute break. Phase 1 ended with a post-exposure likability rating (see earlier) and a recognition test as manipulation checks. In the recognition test participants decided whether a face had been encountered in the news exposure or not (this included 32 additional unfamiliar filler faces).

In Phase 2 the EEG was recorded while a social judgment task was employed as the main task (Fig. 2a). Participants judged how negative, neutral, or positive the depicted person was based on information acquired in Phase 1. Participants judged on a 5-point scale,

enabling them to nuance their answers between neutral and negative / positive. To enhance the signal-to-noise ratio necessary for the EEG data quality, the task was repeated 20 times block-wise, separated by breaks, resulting in 80 trials per condition (excluding fillers). Participants were told that the repetition of the task is a technical necessity for the EEG measurement. Trials started with a 500ms pre-stimulus fixation cross and had a 500ms inter-trial interval. Faces were presented until response or for a maximum of 3 seconds.

Phase 3 entailed manipulation checks of the media sources. First, participants saw the logos and were asked if they knew the sources. Then they rated how trustworthy they consider each source, on a 5-point scale from trustworthy to untrustworthy while the EEG was recorded. The credibility rating was repeated 10 times, resulting in 40 trials per condition and logos were presented until response. At last, participants were asked to rate how likeable they find each media source. This rating was included because likability may not necessarily be equivalent with credibility (e.g. one may enjoy reading a gossip paper, without trusting its contents).

The direction of scales was counterbalanced, i.e. there were two versions, in version one the 5 buttons ranged from positive (left) to negative (right), and in version two from negative (left) to positive (right). This was consistent for all tasks and phases, i.e. very likeable, positive, yes, and very credible on the left for version one and vice versa for version two. After the experiment, participants were asked to reproduce the contents of the headline about each person to check if they remembered the broad information.

EEG Data recording and preprocessing

The EEG was recorded from 62 electrode sites as specified by the extended 10-20 system with Ag/AgCl electrodes. Impedance was kept under 5 kΩ. The sampling rate was 500 Hz, and the continuous signal is referenced to the left mastoid. Horizontal and vertical electrooculograms were obtained with peripheral electrodes at the left and right canthi of both eyes, and above and below the left eye. A short calibration procedure was tracing individual eye movements after the experiment, that are later used to correct for eye movement artifacts.

Offline, the continuous EEG was transformed to average reference and low-pass filtered at 30 Hz pass-band edge. Using BESA (Berg & Scherg, 1991), we removed artifacts due to eye movements by applying a spatiotemporal dipole modeling procedure for each participant individually. Trials with remaining artifacts were rejected, i.e. trials with amplitudes over ± 200 µV, changing more than 50 µV between samples or more than 200 µV within single epochs, or containing baseline drifts. Error- and artifact-free EEG data was

segmented into epochs of 2.5 s, starting 100 ms prior to stimulus onset, with a 100 ms pre-stimulus baseline.

Data analysis

ERP analyses focus on two regions of interest (ROI), the EPN (at electrode sites PO7, PO8, PO9, PO10, TP9, TP10, between 200ms and 350ms after face stimulus onset) and the LPP component (Pz, CPz, POz, P3, P4, 400ms – 600ms), based on previous findings of emotional stimulus content (e.g. Schupp et al., 2003) and affective information (e.g. Abdel Rahman, 2011; Baum et al., 2018). To explore effects occurring during early visual face processing, we additionally analyzed the P100 (PO3, PO4, O1, O2, 100ms – 150ms), and the N170 (P7, P8, PO7, PO8, 150ms – 200ms), based on previous findings (e.g. Abdel Rahman & Sommer, 2012). P100 and N170 results are available in the SI Tables S18-S21. Amplitudes were averaged over ROIs and time windows on single trial level.

We used LMMs on single-trial data of behavioral measures and ERPs to analyze the fixed effects of *headline content* (neutral, negative, positive) and *source credibility* (credible, less credible) on behavioral measures and ERPs (cf. Frömer, Maier, & Abdel Rahman, 2018). We fitted models with a maximal crossed random-effects structure for subjects and face stimuli, with random intercepts and random slopes for the fixed factors' main effects and interactions, thus controlling for subject- and stimuli-specific variance in average responses and in effects of the manipulation. See SI for details on R packages, contrast coding and model specification.

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References

Abdel Rahman, R. (2011). Facing good and evil: Early brain signatures of affective biographical knowledge in face recognition. *Emotion*, *11*(6), 1397–1405. http://doi.org/10.1037/a0024717

Abdel Rahman, R., & Sommer, W. (2012). Knowledge scale effects in face recognition: An electrophysiological investigation. *Cognitive, Affective, & Behavioral Neuroscience*, *12*(1), 161–174. http://doi.org/10.3758/s13415-011-0063-9

Aral, S., & Eckles, D. (2019). Protecting elections from social media manipulation. *Science*, *365*(6456), 858–861. http://doi.org/10.1126/science.aaw8243

Baum, J., Rabovsky, M., Rose, S. B., & Abdel Rahman, R. (2018). Clear judgments based on unclear evidence: Person evaluation is strongly influenced by untrustworthy gossip. *Emotion*. http://doi.org/10.1037/emo0000545

Bliss-Moreau, E., Barrett, L. F., & Wright, C. I. (2008). Individual differences in learning the affective value of others under minimal conditions. *Emotion*, *8*(4), 479–493. http://doi.org/10.1037/1528-3542.8.4.479

Brady, W. J., Wills, J. A., Jost, J. T., Tucker, J. A., & Van Bavel, J. J. (2017). Emotion shapes the diffusion of moralized content in social networks. *Proceedings of the National Academy of Sciences*, *114*(28), 7313–7318. http://doi.org/10.1073/pnas.1618923114

Cunningham, W. A., & Zelazo, P. D. (2007). Attitudes and evaluations: a social cognitive neuroscience perspective. Trends in Cognitive Sciences, 11(3), 97–104. http://doi.org/10.1016/j.tics.2006.12.005

Green, P., & MacLeod, C. J. (2016). SIMR: an R package for power analysis of generalized linear mixed models by simulation. Methods in Ecology and Evolution, 7(4), 493–498. http://doi.org/10.1111/2041-210X.12504

Ellsworth, P. C., & Scherer, K. R. (2003). Appraisal processes in emotion. In R. J. Davidson, K. R. Scherer, & H. H. Goldsmith (Eds.), *Series in affective science.* (pp. 572–595). New York, NY, US: Oxford University Press.

Foster, E. K. (2004). Research on Gossip: Taxonomy, Methods, and Future Directions. *Review of General Psychology*, *8*(2), 78–99. http://doi.org/10.1037/1089-2680.8.2.78

Frömer, R., Maier, M., & Abdel Rahman, R. (2018). Group-Level EEG-Processing Pipeline for Flexible Single Trial-Based Analyses Including Linear Mixed Models. *Frontiers in Neuroscience*, *12*, 970. http://doi.org/10.3389/fnins.2018.00048

Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin*, *132*(5), 692–731. http://doi.org/10.1037/0033-2909.132.5.692

Herbert, C., Pauli, P., & Herbert, B. M. (2011). Self-reference modulates the processing of emotional stimuli in the absence of explicit self-referential appraisal instructions. *Social Cognitive and Affective Neuroscience*, *6*(5), 653–661. http://doi.org/10.1093/scan/nsq082

Herbert, C., Sfärlea, A., & Blumenthal, T. (2013). Your emotion or mine: labeling feelings alters emotional face perception—an ERP study on automatic and intentional affect labeling. *Frontiers in Human Neuroscience*, *7*. http://doi.org/10.3389/fnhum.2013.00378

Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin*, *114*(1), 3–28. http://doi.org/10.1037//0033-2909.114.1.3

Junghöfer, M., Bradley, M. M., Elbert, T. R., & Lang, P. J. (2001). Fleeting images: a new look at early emotion discrimination. *Psychophysiology*, *38*(2), 175–178. https://doi.org/10.1111/1469-8986.3820175

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist*, *58*(9), 697–720. http://doi.org/10.1037/0003-066X.58.9.697

Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, *47*(2), 263. http://doi.org/10.2307/1914185

Kissler, J., Herbert, C., Peyk, P., & Junghöfer, M. (2007). Buzzwords early cortical responses to emotional words during reading. *Psychological Science*, *18*(6), 475–480. http://doi.org/10.1016/j.biopsycho.2008.03.004

Lazer, D. M. J., Baum, M. A., Benkler, Y., Berinsky, A. J., Greenhill, K. M., Menczer, F., et al. (2018). The science of fake news. *Science*, *359*(6380), 1094–1096. http://doi.org/10.1126/science.aao2998

Lewandowsky, S., Ecker, U. K. H., Seifert, C. M., Schwarz, N., & Cook, J. (2012). Misinformation and Its Correction: Continued Influence and Successful Debiasing. *Psychological Science in the Public Interest*, *13*(3), 106–131. http://doi.org/10.1177/1529100612451018

Lieberman, M. D. (2007). Social Cognitive Neuroscience: A Review of Core Processes. *Annual Review of Psychology*, *58*(1), 259–289. http://doi.org/10.1146/annurev.psych.58.110405.085654

Luo, Q. L., Wang, H. L., Dzhelyova, M., Huang, P., & Mo, L. (2016). Effect of Affective Personality Information on Face Processing: Evidence from ERPs. *Frontiers in Psychology*, *7*, 1397. http://doi.org/10.3389/fpsyg.2016.00810

Menninghaus, W., Wagner, V., Hanich, J., Wassiliwizky, E., Jacobsen, T., & Koelsch, S. (2017). The Distancing-Embracing model of the enjoyment of negative emotions in art reception. Behavioral and Brain Sciences, 40, 26. http://doi.org/10.1017/S0140525X17000309

Metzger, M. J., & Flanagin, A. J. (2013). Credibility and trust of information in online environments: The use of cognitive heuristics. *Journal of Pragmatics*, *59*, 210–220. http://doi.org/10.1016/j.pragma.2013.07.012

Öhman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: Toward an evolved module of fear and fear learning. *Psychological Review*, *108*(3), 483–522. http://doi.org/10.1037/0033-295X.108.3.483

Pennycook, G., & Rand, D. G. (2018). Lazy, not biased: Susceptibility to partisan fake news is better explained by lack of reasoning than by motivated reasoning. *Cognition*. http://doi.org/10.1016/j.cognition.2018.06.011

Pennycook, G., & Rand, D. G. (2019). Fighting misinformation on social media using crowdsourced judgments of news source quality. *Proceedings of the National Academy of Sciences*, *116*(7), 2521–2526. http://doi.org/10.1073/pnas.1806781116

Rellecke, J., Sommer, W., & Schacht, A. (2012). Does processing of emotional facial expressions depend on intention? Time-resolved evidence from event-related brain potentials. *Biological Psychology*, *90*(1), 23–32. http://doi.org/10.1016/j.biopsycho.2012.02.002

Sabatinelli, D., Keil, A., Frank, D. W., & Lang, P. J. (2013). Emotional perception: Correspondence of early and late event-related potentials with cortical and subcortical functional MRI. *Biological Psychology*, *92*(3), 513–519. http://doi.org/10.1016/j.biopsycho.2012.04.005

Schacht, A., & Sommer, W. (2009a). Emotions in word and face processing: Early and late cortical responses. *Brain and Cognition*, *69*(3), 538–550. http://doi.org/10.1016/j.bandc.2008.11.005

Schacht, A., & Sommer, W. (2009b). Time course and task dependence of emotion effects in word processing. *Cognitive, Affective, & Behavioral Neuroscience*, *9*(1), 28–43. http://doi.org/10.3758/CABN.9.1.28

Scherer, K. R. (2001). Appraisal considered as a process of multilevel sequential checking. In K. R. Scherer, A. Schorr, & T. Johnstone (Eds.), *Series in affective science.* (pp. 92–120). New York, NY, US: Oxford University Press.

Schindler, S., Vormbrock, R., & Kissler, J. (2019). Emotion in Context: How Sender Predictability and Identity Affect Processing of Words as Imminent Personality Feedback. *Frontiers in Psychology*, *10*, 327. http://doi.org/10.3389/fpsyg.2019.00094

Schupp, H. T., Junghöfer, M., Weike, A. I., & Hamm, A. O. (2003). Emotional Facilitation of Sensory Processing in the Visual Cortex. *Psychological Science*, *14*(1), 7–13. http://doi.org/10.1111/1467-9280.01411

Schupp, H. T., Öhman, A., Junghöfer, M., Weike, A. I., Stockburger, J., & Hamm, A. O. (2004). The Facilitated Processing of Threatening Faces: An ERP Analysis. *Emotion*, *4*(2), 189–200. http://doi.org/10.1037/1528-3542.4.2.189

Smith, C. T., De Houwer, J., & Nosek, B. A. (2012). Consider the Source. *Personality and Social Psychology Bulletin*, *39*(2), 193–205. http://doi.org/10.1177/0146167212472374

Strack, F., & Deutsch, R. (2004). Reflective and Impulsive Determinants of Social Behavior. *Personality and Social Psychology Review*, *8*(3), 220–247. http://doi.org/10.1207/s15327957pspr0803_1

Suess, F., Rabovsky, M., & Abdel Rahman, R. (2015). Perceiving emotions in neutral faces: expression processing is biased by affective person knowledge. *Social Cognitive and Affective Neuroscience*, *10*(4), 531–536. http://doi.org/10.1093/scan/nsu088

Todorov, A., Gobbini, M. I., Evans, K. K., & Haxby, J. V. (2007). Spontaneous retrieval of affective person knowledge in face perception. *Neuropsychologia*, *45*(1), 163–173. http://doi.org/10.1016/j.neuropsychologia.2006.04.018

Uhlmann, E. L., Pizarro, D. A., & Diermeier, D. (2015). A Person-Centered Approach to Moral Judgment. *Perspectives on Psychological Science*, *10*(1), 72–81. http://doi.org/10.1177/1745691614556679

Vosoughi, S., Roy, D., & Aral, S. (2018). The spread of true and false news online. *Science*, *359*(6380), 1146–1151. http://doi.org/10.1126/science.aap9559

Wieser, M. J., Gerdes, A. B. M., Büngel, I., Schwarz, K. A., Mühlberger, A., & Pauli, P. (2014). Not so harmless anymore: How context impacts the perception and electrocortical processing of neutral faces. *NeuroImage*, *92*(C), 74–82. http://doi.org/10.1016/j.neuroimage.2014.01.022

Xu, M., Li, Z., Diao, L., Fan, L., & Yang, D. (2016). Contextual Valence and Sociality Jointly Influence the Early and Later Stages of Neutral Face Processing. *Frontiers in Psychology*, *07*(1368), 1446. http://doi.org/10.1016/j.biopsycho.2014.11.012

Zillmann, D. (2008). Excitation Transfer Theory (Vol. 89). Chichester, UK: John Wiley & Sons, Ltd. http://doi.org/10.1002/9781405186407.wbiece049