

## **Pausing to Reflect During News Consumption Counteracts Negativity Biases in Memory**

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## **Abstract**

News sources often emphasize negative information, which can be harmful for mood, memory, and mental health. Here, we investigated information seeking and memory during the early phase of the COVID-19 pandemic. Participants (N=260) completed a naturalistic information seeking task in which they explored brief articles in a virtual Newsroom. In the Reflection condition, participants were prompted to pause and reflect on how information made them feel, whereas participants in the No-Reflection condition browsed uninterrupted. We later assessed memory for the Newsroom information. Crucially, our reflection intervention reduced negativity biases in memory. No-Reflection participants were biased to remember negative information and forget positive information, especially if they were in a negative mood state. In contrast, Reflection participants showed better memory for positive information, especially if it was surprising. Overall, we found that a simple intervention—pausing to reflect while reading news—restored the balance between positive and negative information in memory.

## General Audience Summary

Seeking information can help us resolve uncertainty and prepare for the future. In times of crisis, news sources and social media can provide valuable information. However, news sources often emphasize negative information to capture attention. Engaging with negative information can lead us to selectively remember negative information while forgetting positive information. This *negativity bias* has downstream consequences for mental health and wellbeing. For example, fixating on negative information can prevent us from finding solutions and taking action. Here, we investigated how individuals sought and remembered information during an acute global crisis: the lockdown phase of the COVID-19 pandemic in the U.S. (April 2020). Crucially, we showed that a simple intervention—prompting individuals to pause and reflect on how information made them feel—counteracted the negativity bias by enhancing memory for surprising positive information. In contrast, participants who did not pause to reflect were biased to remember negative information and forget positive information, especially if it was surprising. This negativity bias was strongest for participants who were in a negative mood. Overall, we show that consuming negative media without pausing to reflect (e.g., “doom-scrolling” on endless social media feeds) can lead to memory biases that may harm mental health. In contrast, pausing to reflect restores the balance between positive and negative information in memory. We offer a simple strategy to ensure that positive information is not forgotten amongst the negative information—pausing to reflect on how information makes you feel.

## Introduction

In times of crisis, seeking information can bring clarity and comfort. Disruptions to everyday life, whether on an individual level (e.g., losing a job) or at the population scale (e.g., pandemics, political unrest, or climate change) can increase environmental uncertainty and societal instability. Seeking information in response to such challenges is often beneficial—information can reduce uncertainty and guide decision-making by helping us assess risks and plan for the future (Edwards & Slovic, 1965; Gershman, 2019; Gottlieb & Oudeyer, 2018). News and social media outlets can be valuable sources of up-to-date information about developing events. However, news is often negative, fueling engagement and driving information sharing (Hornik et al., 2015; Krawczyk et al., 2021; Robertson et al., 2023; Soroka & McAdams, 2015) while negatively impacting affect and wellbeing (de Hoog & Verboon, 2020; Knobloch-Westerwick, 2021; Shaikh et al., 2022; Soroka et al., 2019). Here, we investigated how individuals sought and remembered information during a global crisis: the early phase of the COVID-19 pandemic, when 90% of U.S. residents were restricted by some form of stay-at-home order. We tested an intervention that aimed to reduce negativity biases in memory for news.

Information seeking during a crisis can have both positive and negative effects. Positive effects include uncertainty reduction and an increase in beneficial behaviors. For example, shortly after natural disasters (e.g., earthquakes, hurricanes, and tsunamis), social media usage spikes as individuals rapidly seek and share crisis-related information (Fraustino et al., 2012). Seeking and sharing such information can warn at-risk individuals, encourage preventative behaviors, and speed evacuation and rescue attempts. During the COVID-19 pandemic, individuals who sought more information about COVID-19 reported engaging in more preventative behaviors like hand washing, social distancing, and wearing face masks (Liu, 2020).

However, exposure to negative information has repercussions for memory and mood. Negative stimuli tend to be remembered better than neutral or positive stimuli (Bowen et al., 2018; Kensinger, 2004, 2009). Negative stimuli also capture attention, dominate first impressions, and bias judgments (Baumeister et al., 2001; Rozin & Royzman, 2001). Surprise and arousal can also enhance memory (Clewett & Murty, 2019; Schomaker & Meeter, 2015), which may modulate the impact of both positive and negative information. Furthermore, negativity biases can be *self-reinforcing*, because negative mood states bias attention towards negative stimuli (Becker & Leininger, 2011) and enhance memory biases, prioritizing encoding and retrieval of negative information (Bower, 1981; Faul & LaBar, 2022; Mineka & Nugent, 1995). Negative mood states may also lead to mood-congruent information seeking, though prior studies have shown mixed and inconclusive effects (Kustubayeva et al., 2012; Mitchell, 2001).

Perhaps as a result of these negativity biases in attention and memory, negative news can be harmful for mental health. Consumption of disaster media coverage has been linked to negative mental health outcomes, including posttraumatic stress, anxiety, and depression (Pfefferbaum et al., 2014). During the early stages of the COVID-19 pandemic, media coverage was predominantly negative—one study found that 81% of COVID-related online news articles skewed negative (Krawczyk et al., 2021). Consumption of COVID-19 news has been linked to decreased wellbeing and increased distress, worry, and anxiety (Heffner et al., 2021; Liu, 2020; Nekliudov et al., 2020; Riehm et al., 2019; Stainback et al., 2020). Such effects can also be long-lasting: an 11-week longitudinal study about time-use during lockdown found that time spent reading COVID-19 news predicted declines in mental health and wellbeing (Bu et al., 2021). In particular, engaging with COVID-19 content on social media (relative to traditional media sources) was linked to anxiety and “information overload” (Heffner et al., 2021; Soroya et al.,

2021). Beyond the COVID-19 pandemic, prior studies have provided both correlational and causal evidence that negative news induces negative affect (de Hoog & Verboon, 2020; Knobloch-Westerwick, 2021; Shaikh et al., 2022; Soroka et al., 2019).

Importantly, however, interventions can change the way that individuals *engage* with negative news, potentially reducing the harmful effects of negative information. One study showed that a 14-day mindfulness training intervention (teaching individuals to reflect on their emotions, thoughts, and sensations) reduced negative affect elicited by reading negative news about climate change (Yang et al., 2023). In another study, participants read information about the COVID-19 pandemic (Bazán et al., 2021). Negative information worsened mood, but pausing to complete a relaxation exercise after reading protected against this effect. Interventions that redirect focus towards internal emotional states can thus protect against the harmful effects of negative information. Although these two studies have used reflection or relaxation interventions to reduce the effect of negative news on mood, to our knowledge, no prior studies have tested interventions to counteract negativity biases in *memory* for news. Furthermore, prior interventions have not attempted to change how participants reflect *during* information consumption.

Overall, negative news can have detrimental effects on mood and mental health. Negative information is prioritized in memory, which may lead to individuals to ruminate on negative information and struggle to recall uplifting or actionable information. In the present study, we designed a naturalistic “Newsroom” task to examine self-directed information seeking during the early phase of the COVID-19 pandemic. Some participants explored the Newsroom uninterrupted (No-Reflection condition), whereas others were periodically prompted to pause and reflect on how the information made them feel (Reflection condition). We later tested

memory for information encountered in the Newsroom. Our first aim was to investigate how information valence and surprisingness influenced information seeking and memory outcomes. Our second aim was to test whether our novel intervention—prompting participants to pause and reflect on how information made them feel—would reduce negativity biases in information seeking and subsequent memory.

## **Method**

### **Participants**

Our target sample size was 300 participants; we chose this target to provide adequate power to detect small-to-medium between-subjects effects when comparing the two conditions. In total, 302 participants (ages 18+, U.S. residents, fluent in English) completed the study via Prolific ([www.prolific.co](http://www.prolific.co)), an online labor marketplace. Data collection took place on April 16<sup>th</sup>, 2020. The study took place during the uncertain early phase of the pandemic; at the time of data collection, 90% of U.S. residents were restricted by some form of stay-at-home order due to COVID-19. Participants completed the entire study online, using their own personal computers. Participants were paid \$6.50 for completing the study; the average completion time was 35 minutes (\$11.14 USD/hour). All participants provided informed consent by clicking a button on an online consent form. The study was approved by the Duke University Campus Institutional Review Board (protocol #2019-0297).

We excluded 42 participants for the following reasons (note that five participants met more than one of these exclusion criteria): one participant did not meet our inclusion criteria according to responses on the demographics survey, one participant did not attempt the Newsroom task, eight participants had corrupted Newsroom data files due to a technical error, 12

participants did not complete the self-report survey component of the task (hosted on Qualtrics), 14 participants did not label their Newsroom data with their Prolific ID, 7 participants exited and then re-entered the Newsroom task, and 4 participants failed an attention check. This resulted in a final sample of 260 participants who successfully completed both the Qualtrics surveys and the Newsroom task (n = 121 in the Reflection condition, n = 139 in the No-Reflection condition).

Within our sample, 54.2% of participants identified as women, 44.4% identified as men, and 1.4% identified as non-binary or a different gender. The mean age of our participants was 29.3 years (SD = 10.2 years; range = 18-72 years). The distribution of self-reported racial identity was as follows: 64.9% White, 14.9% Asian, 7.4% Black/African-American, 8.4% two or more races, and 4.2% other.

We also collected a separate sample of 211 US adults through Amazon Mechanical Turk, a different online labor marketplace, to rate the information in the Newsroom in April of 2020. Raters completed the entire study online, using their own personal computers. We excluded 31 participants for failing to meet baseline task engagement assessed via attention checks, resulting in a final sample of 180 participants. The rating task was estimated to take 10 minutes and participants were paid a flat \$2.50 for completion of the task. All participants provided informed consent under the guidelines of our university's Institutional Review Board. Demographic information was not collected for the sample of participants who rated the stimuli.

## **Materials & Stimuli**

### ***Pre-Newsroom Questionnaires***

Participants first completed the abbreviated version of the Profile of Mood States (Grove & Prapavessis, 1992), which assesses an individual's current mood, with a particular emphasis on negative mood states. Participants view 40 different mood states and rate how much their



current mood matches each item, using a 5-point Likert scale ranging from “not at all” to “extremely”. Subscales scores (tension, anger, fatigue, depression, esteem-related affect, vigor, and confusion) were calculated by summing the item responses in each subscale (reverse scoring applied for some items). The *Total Mood Disturbance* score measures the individual’s broad level of distress by summing the scores of the negative mood state subscales (tension, depression, anger, fatigue, confusion) while subtracting the positive mood state subscales (vigor, esteem-related affect).

Participants also rated how much they felt they already knew about each of the Newsroom Headlines on a 5-point Likert scale (“How much do you already know about this topic?”; scale points: nothing, a little, some, a lot, everything). Lastly, participants responded to a custom questionnaire that probed their experiences with uncertainty and instability during the early stage of the COVID-19 pandemic. These measures of individual differences were not analyzed in the present study.

### ***News Items***

Information used in the Newsroom was collected from reliable news and pop-culture sources (e.g., the New York Times, the World Health Organization) in the week prior to the launch of the study. Information was grouped into four categories, (*Entertainment and Distraction, Cases, Deaths, and Statistics, Preparing for COVID-19, Social and Community Information*). Each category of information contained three “articles,” each described by a headline. Each article contained three related pieces of information that were presented sequentially. All Newsroom headlines and articles are provided in the Supplemental Material (*Newsroom Information*). In addition, we created a fourth “lure” piece of information matched to

the topic of each article. These lure items were withheld from the Newsroom and later presented during the memory test.

Our sample of raters ( $N = 180$ ), recruited from Amazon Mechanical Turk (MTurk) on the same day as the primary Prolific sample, independently read all the newsroom information and headlines, including the novel lure information for the memory test, and rated (using 7-point Likert scales) the valence, intensity, surprisingness, novelty, and trustworthiness of each piece of information. We used these independent ratings to compare how different information variables influenced information seeking and memory across conditions. Importantly, although participants in the Reflection condition provided subjective ratings on each trial, statistical analyses rely on normed ratings from the independent sample, allowing us to directly compare the Reflection and No Reflection conditions. Here, we focus on the valence and surprise ratings, as these factors corresponded to the reflection prompts used in the study.

### *Post-Newsroom Questionnaires*

After completing the Newsroom task, participants completed several surveys and questionnaires. These measures were included to assess potential individual differences and fill a brief delay period between the Newsroom and the subsequent memory test. As these questionnaires are beyond the scope of the present paper, we do not report exploratory analyses of individual differences.

Participants first answered 15 questions about their personal experiences during the COVID-19 pandemic; these questions were adapted from a questionnaire used in a prior study (Anet et al., 2020). Questions probed various thoughts and concerns about the pandemic (e.g., overall worry, perceived risk of getting sick due to COVID-19, economic impact of the pandemic, predicted length of shutdown measures) as well as self-reported behaviors (e.g., social

distancing, hand washing). In addition to these questions, participants also reported disruptive life changes that they may have experienced since the pandemic began.

Participants also completed the Intolerance of Uncertainty Scale (Buhr and Dugas, 2002), Kashdan's Five-Dimensional Curiosity Scale (Kashdan et al., 2018), and the Brief COPE questionnaire (Carver, 1997), which measures coping behaviors in response to stressors. Lastly, participants completed a demographics survey in which they self-reported gender, age, birth country, how long they had lived in the United States, state of residence, zip code, county, primary occupation, whether they had lost their job due to the COVID-19 pandemic, racial or ethnic heritage, pre-tax income, highest degree of education, political leaning (conservative to liberal) on social and economic issues, and past or current psychiatric diagnoses.

## **Procedure**

Participants first completed the Pre-Newsroom Questionnaires described above. Overall, these questions assessed their prior knowledge of COVID-19 topics and their current mood state. Participants then began the Newsroom Task. Prior to entering the Newsroom, participants were instructed that they would be able to browse articles about a variety of topics related to the COVID-19 pandemic. Participants were informed that full compensation for the study was contingent on their entering the Newsroom. Once in the Newsroom, however, participants could choose to read as many or as few articles as they pleased. Engagement with the Newsroom was self-paced; participants could freely interact with the articles and choose when to exit.

Upon entering the Newsroom, participants first viewed the *Main Menu* (Figure 1A), which presented large buttons indicating four categories of information: "Entertainment and Distraction", "Cases, Deaths, and Statistics", "Preparing for COVID-19", and "Social and Community Information." The ordering of the categories was randomized between participants.

The Main Menu also included a button to exit the newsroom. Participants could choose any of the four categories. Selecting a category brought the participant to a *Headline Screen*, which displayed three different headlines corresponding to articles within the chosen category (Figure 1B). Selecting a headline brought the participant to an article that was divided into three sequential *Information Screens* (Figure 1C).

Each Information Screen contained a couple of sentences topically related to the headline. For instance, within an article with the headline “Tips for Working from Home”, the first Information Screen read, “Social accountability can help you set daily goals and sustain your motivation. Try writing down your daily to-do list; share it with a friend or coworker and check in about your progress at the beginning and/or end of each day.” Participants could progress through each Information Screen, selecting ‘Next’ to continue with the article or the Main Menu button to exit the article and return to the Main Menu. Each article contained three Information Screens; if a participant chose to continue through all three screens for an article, they were told they had reached the end of the article and would return to the Main Menu on their next click. We chose to return participants to the Main Menu after each article to allow participants to actively choose categories instead of passively returning them to the previous category.

Before entering the Newsroom, participants were randomly assigned to one of two between-subjects conditions: the *Reflection* and *No-Reflection* conditions. In the No-Reflection condition, participants navigated through the Newsroom as described above, with no interruptions. In the Reflection condition, we asked participants to pause and reflect on the information they had just read after each Information Screen. Participants rated whether they felt better or worse after reading the previous piece of information; they also rated how surprising

they found the piece of information (Figure 1D). Participants were not informed that some other participants experienced a different version of the task. We did not collect any measures of individual differences in the experience of reflection (e.g., strategies used, ease of reflection).

From the Main Menu, participants could explore new categories and articles or re-read information that they had already viewed. Participants freely explored the Newsroom for a self-determined amount of time. To end the Newsroom Task at any time, participants selected the 'Exit' button from the Main Menu.

After exiting the Newsroom, participants completed the Post-Newsroom Questionnaires, described above. Lastly, participants completed a surprise memory test on all pieces of information that may or may not have been read in the Newsroom. Participants provided Old/New recognition judgements for each piece of information and provided confidence ratings. In addition to all Information Screens that were present in the Newsroom, the memory test included novel lures matched to each article topic. The memory test was self-paced.

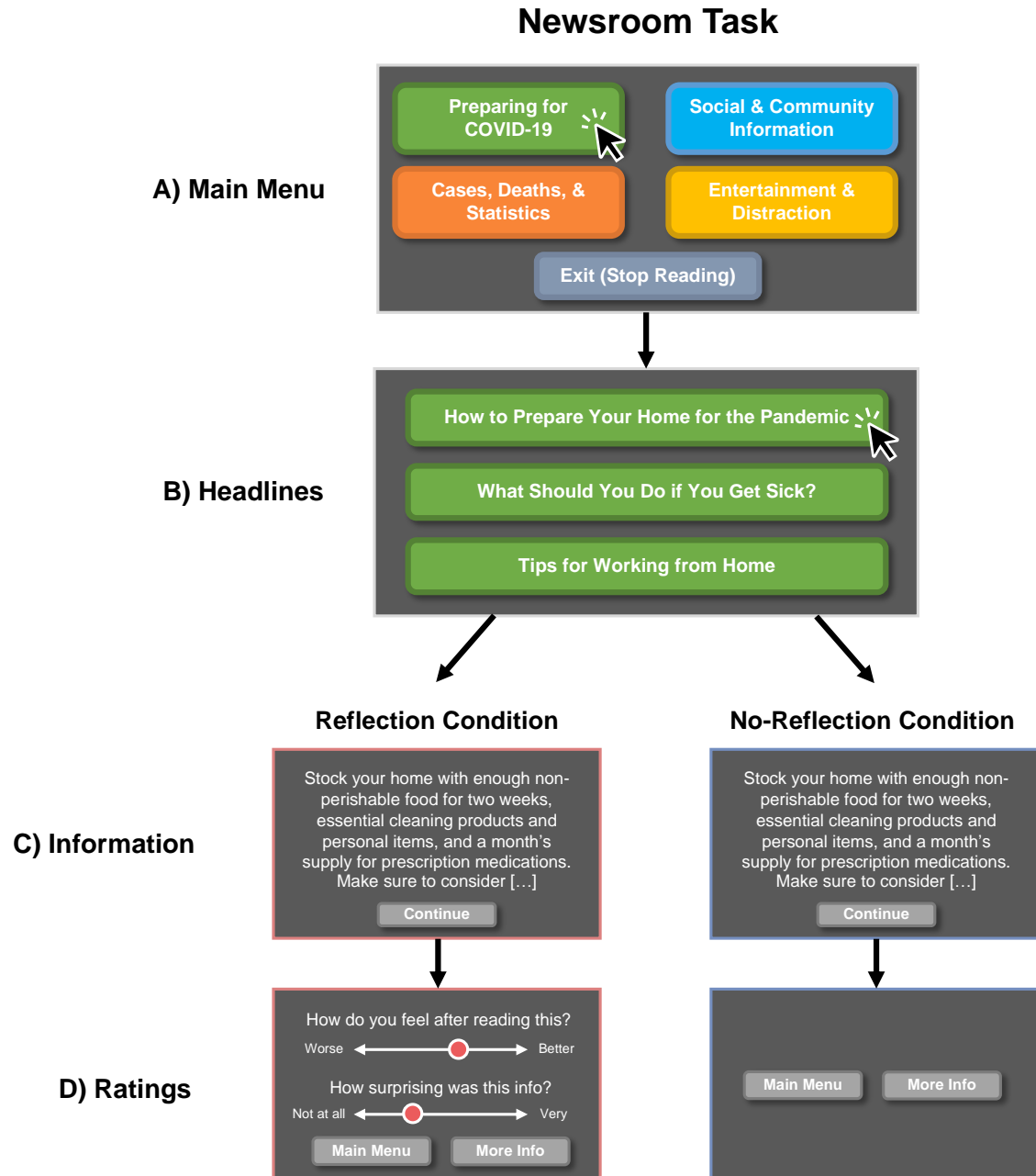
### **Statistical Analysis**

Data were analyzed with R (v4.1.1), implemented in R Studio (v2021.09.0). Statistical significance was assessed for mixed-effects models with Satterthwaite estimates of degrees of freedom. All continuous variables were z-scored in statistical models, though original units are shown in figures. All models converged successfully. Further information about models (e.g., random effects) are reported in detail in Supplementary Tables 1 and 2.

Due to the self-guided nature of our task, some participants encountered a given piece of information multiple times. On most trials (85%), participants only viewed a given piece of information once. However, on 15% of trials, participants viewed the same piece of information multiple times. These repeat viewings were typically associated with very short reading times.

We restricted our analyses to the first time a participant viewed each piece of information (excluding duplicate trials) but included a covariate to account for the total number of times the participant viewed each piece of information. Furthermore, as this was a self-paced task, we observed excessively long reaction times on some trials. These extreme outlier observations were winsorized to the 95% percentile; reaction time was included as a covariate in some analyses but was not a variable of interest.

As noted above, variables pertaining to information valence and surprisingness were obtained from an independent sample of MTurk raters ( $N = 180$ ). We calculated the average valence and surprise scores for each information page that was included in the Newsroom. These valence and surprise scores were then related to memory outcomes in the Prolific sample of participants who completed the Newsroom task.



*Figure 1.* Overview of Newsroom task. Participants engaged in self-paced, free navigation of a virtual Newsroom featuring four information categories (A). Each category included three articles, identified by headlines (B). Each article included three sequential pieces of related information. Panel (C) depicts one information page from an article. Participants in the Reflection condition were prompted to pause and reflect on how each information page made them feel, providing ratings about whether the information made them feel better or worse, and how surprising they found the information (D). Participants in the No Reflection condition were able to proceed to the next information page without providing ratings. After each information

page, participants chose whether to continue reading more information from the article or return to the Main Menu. Later, participants completed a surprise recognition memory test.

## Results

### Information Seeking

First, we examined whether the *amount* of information viewed in the Newsroom differed between our Reflection and No Reflection conditions. We also investigated whether the *type* of information sought after, as reflected by the categories of information (Figure 1A), differed across our two conditions. We ran a 2x4ANOVA with both *condition* (Reflection or No Reflection) and *information category* (Statistic, Social, Prepare, Distract) as predictors and the interaction between condition and category. We found a significant difference in the amount of information viewed across conditions ( $F(1, 1032) = 19.03, p < 0.001$ ). Post hoc comparisons using the Tukey HSD test revealed that people in the Reflection condition viewed less information ( $M = 18.6$  Information Screens,  $SD = 12.8$ ) than participants in the No Reflection condition ( $M = 22.7$  Information Screens,  $SD = 13.2$ ) (Supplementary Figure 1A).

We also found differences in the amount of information viewed as a function of the information category ( $F(3, 1032) = 3.95, p = 0.008$ ), indicating that more information was viewed from the Statistics category compared to the Social category ( $p = 0.006$ ). There were no other significant differences among categories of information (Supplementary Figure 1B). Lastly, we did not find any differences in the category of information viewed as a function of being in the Reflection or No Reflection condition ( $F(3, 1032) = 1.27, p = 0.284$ ). Taken together, these results suggest that pausing to reflect on the information viewed resulted in sampling less information but did not alter which category information was sampled from.



We next examined whether the information viewed across each condition (Reflection vs. No Reflection) differed in the qualities of that information (i.e., emotional valence and surprise ratings provided by the independent MTurk sample). Using a linear regression, we tested for difference in the valence, intensity, and surprisingness of viewed information across the Reflection and No Reflection condition. We found a marginal difference in the valence of information across the two conditions ( $\beta = -0.06$ , 95% CI [-0.12, 0.001],  $t = -1.91$ ,  $p = 0.057$ ), suggesting that participants in the No Reflection condition tended to view slightly more negative information than participants in the Reflection condition. Notably, participants selected headlines rather than individual pieces of information; the headlines did not always clearly predict whether the information contained within an article would be positive or negative. We found no differences in the intensity, or the surprisingness of information viewed between the two conditions (all  $p > 0.05$ ). Overall, reflecting on viewed information may have guided individuals towards more positive information, but reflection did not change the type of information sought.

### **Memory Outcomes**

First, we investigated whether memory outcomes differed across the Reflection and No-Reflection conditions. We were also interested in whether the qualities of the information (i.e., emotional valence and surprise) influenced memory, and whether these qualities interacted with reflection. Using a mixed-effects logistic regression model, we predicted trial-by-trial *recognition memory accuracy* (0 = forgotten, 1 = remembered) for information previously seen in the Newsroom from the variables *condition* (Reflection or No Reflection), *surprise* (ratings provided by the independent Mturk sample, continuous variable), *valence* (ratings provided by the MTurk sample, continuous variable), and all 17 interactions. In addition, we controlled for *reading time* on each trial, *number of exposures* (i.e., the total number of times the participant

viewed a particular piece of information, overall *information load* (i.e., the total number of pages read by the participant), *information category* (Statistics, Preparation, Social, and Distraction), and *confidence rating* provided during the memory test. Additional model information and all parameter estimates are provided in Supplementary Table 1.

Overall, participants in the Reflection condition were significantly more likely to remember the information they read in the Newsroom, relative to participants in the No Reflection condition ( $\beta = 0.28$ , 95% CI [0.08, 0.47],  $z = 2.82$ ,  $p = 0.005$ ). There was a main effect of valence, such that negative information was more likely to be remembered than positive information ( $\beta = -0.39$ , 95% CI [-0.62, -0.17],  $z = -3.39$ ,  $p = 0.0007$ ) (Figure 3A). There was no main effect of surprise ( $\beta = 0.08$ , 95% CI [-0.14, 0.29],  $z = 0.70$ ,  $p = 0.487$ ), but surprise interacted with valence ( $\beta = 0.27$ , 95% CI [0.13, 0.41],  $z = 3.75$ ,  $p = 0.0002$ ), such that surprise selectively enhanced the memorability of positive information (Figure 3B).

Importantly, there was also a three-way interaction among condition, surprise, and valence predicting recognition memory ( $\beta = 0.36$ , 95% CI [0.23, 0.48],  $z = 5.61$ ,  $p < 0.0001$ ). This interaction revealed that the memory benefits of the Reflection condition depended on information content (Figure 3C). For participants in the Reflection condition, surprise enhanced memory for positively-valenced information, perhaps strengthening encoding of information that otherwise may be forgettable ( $\beta = 1.08$ ,  $z = 5.39$ ,  $p < 0.0001$ ). In contrast, negatively-valenced information was memorable regardless of surprise ( $\beta = -0.18$ ,  $z = -0.92$ ,  $p = 0.357$ ). However, for participants in the No Reflection condition, surprising positive information was *less* likely to be remembered ( $\beta = -0.39$ ,  $z = -3.14$ ,  $p = 0.002$ ), whereas surprise did not influence memory for negative information ( $\beta = -0.21$ ,  $z = -1.39$ ,  $p = 0.163$ ). Interestingly, confidence intervals depicted in Figure 3C indicated that No-Reflection participants showed greater variance in

memory outcomes for surprising positive information (i.e., suggesting substantial individual differences), whereas Reflection participants consistently showed excellent memory for surprising positive information.

There was also a two-way interaction between surprise and condition, driven by the three-way interaction described above ( $\beta = 0.37$ , 95% CI [0.20, 0.55],  $z = 4.25$ ,  $p < 0.0001$ ); the effect of surprise enhancing memory was stronger in the Reflection condition. Overall, these interactions revealed that actively reflecting on information selectively enhanced memory for positive information, without sacrificing memory for negative information. Reflection reduced the negativity bias in memory by allowing surprise to enhance memory for positive information. Several covariates were also significantly related to memory performance. As expected, confidence ratings were positively related to memory accuracy ( $\beta = 1.08$ , 95% CI [0.96, 1.19],  $z = 18.29$ ,  $p < 0.0001$ ), such that high-confidence responses were more likely to be correct. Reading time was also positively related to memory accuracy ( $\beta = 0.60$ , 95% CI [0.45, 0.74],  $z = 8.05$ ,  $p < 0.0001$ ); when participants spent more time reading a piece of information, they were more likely to remember it later. Memory performance also differed across topic categories; pairwise contrasts (adjusted for multiple comparisons with Tukey's HSD) revealed that information from the Social category was most memorable, significantly more so than information from the Statistics category ( $\beta = 0.92$ , 95% CI [0.31, 1.45],  $z = 4.15$ ,  $p = 0.0002$ ) and the Distract category ( $\beta = 0.91$ , 95% CI [0.47, 1.31],  $z = 5.48$ ,  $p < 0.0001$ ). Lastly, individual differences in overall information load (total number of information pieces sampled) were positively associated with memory ( $\beta = 0.19$ , 95% CI [0.04, 0.35],  $z = 2.44$ ,  $p = 0.015$ ). Therefore, participants who read more information showed *better* memory performance, perhaps reflecting deeper task engagement. Importantly, this effect demonstrates that participants in the

Reflection condition did not simply show better memory performance because they sampled less information.

### **Mood-Dependent Memory Effects**

Next, we tested whether mood influenced learning. To measure mood, we used the Profile of Mood States (POMS), which was administered before participants began the Newsroom task. Using a subset of the POMS items, we calculated *total mood disturbance* scores, a composite measure of negative affect. Notably, baseline POMS total mood disturbance scores did not differ between the Reflection and No Reflection conditions ( $t_{(1,258)} = -0.29$ ,  $p = 0.7714$ ,  $d = -0.04$ , 95% CI [-0.28, 0.21]).

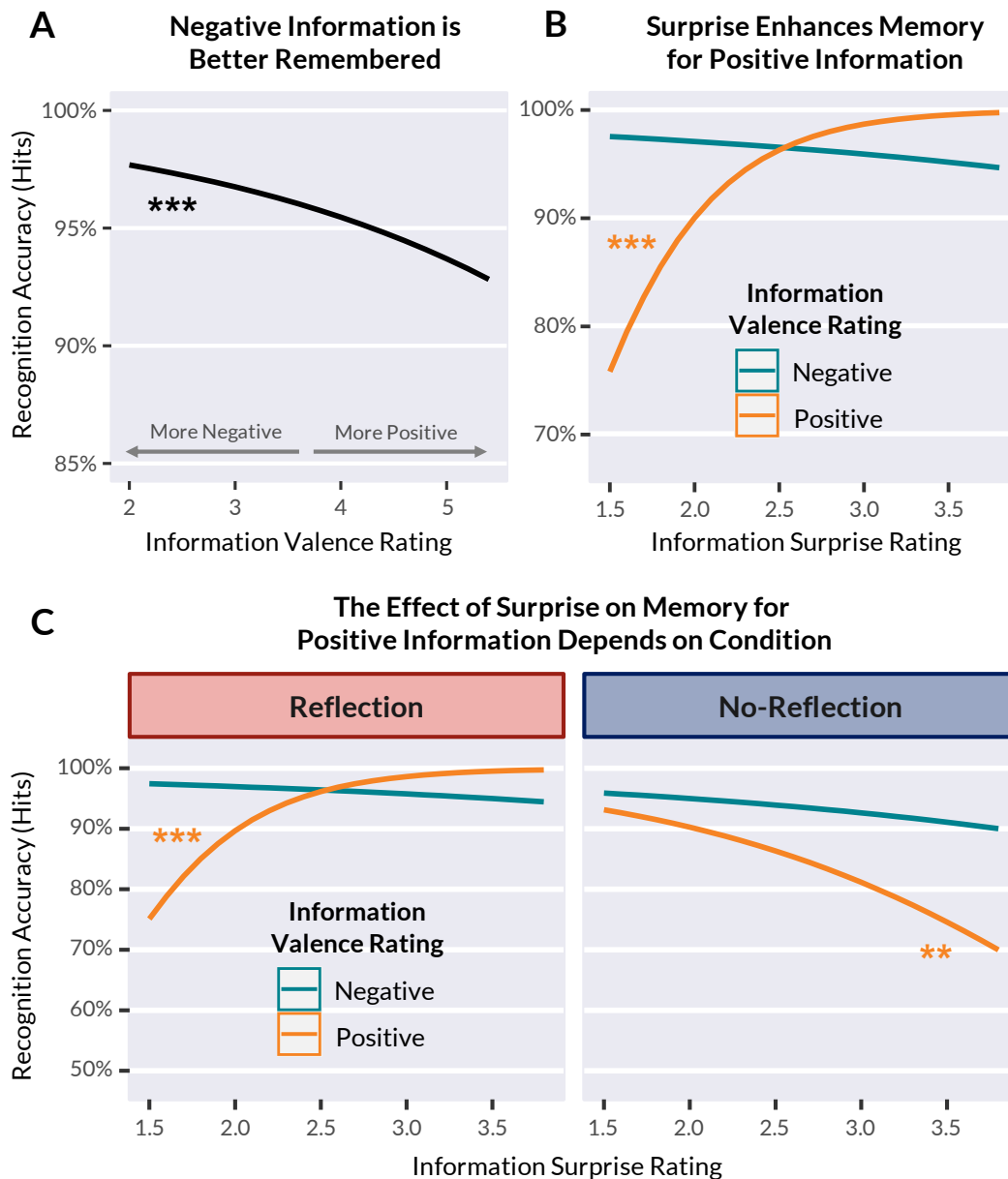
We predicted a mood-congruent encoding bias, such that individuals who were in a negative mood state before beginning the Newsroom task would be biased to remember negative information and forget positive information. However, we expected that the Reflection condition would counteract this mood-congruent encoding bias, rescuing the memorability of positive information for participants in negative mood states. We modified the model described above by adding a parameter for participants' POMS total mood disturbance scores (a summary measure of negative affect) and all relevant interaction terms. All model details are reported in Supplementary Table 2.

Supporting our predictions, we found a four-way interaction among POMS total mood disturbance, condition, surprise, and valence ( $\beta = 0.14$ , 95% CI [0.01, 0.27],  $z = 2.03$ ,  $p = 0.042$ ). This interaction revealed that participants in the No Reflection condition were particularly susceptible to mood-congruent encoding effects: Individuals who were experiencing a negative mood state (high POMS total mood disturbance) were selectively less likely to remember positive information read in the Newsroom, and surprise failed to counteract this bias (Figure

4B). Interestingly, for No-Reflection participants in a negative mood state, surprise *decreased* the memorability of positive information, suggesting that schema-inconsistent positive information was rejected instead of encoded. Conversely, for participants in the Reflection condition, surprise *enhanced* the memorability of positive information, regardless of mood state (Figure 4A). There was no main effect of POMS total mood disturbance, nor any involvement in lower-order interactions (Supplementary Table 2). All other parameter estimates were consistent with the prior model, which did not include POMS scores (Supplementary Table 1).

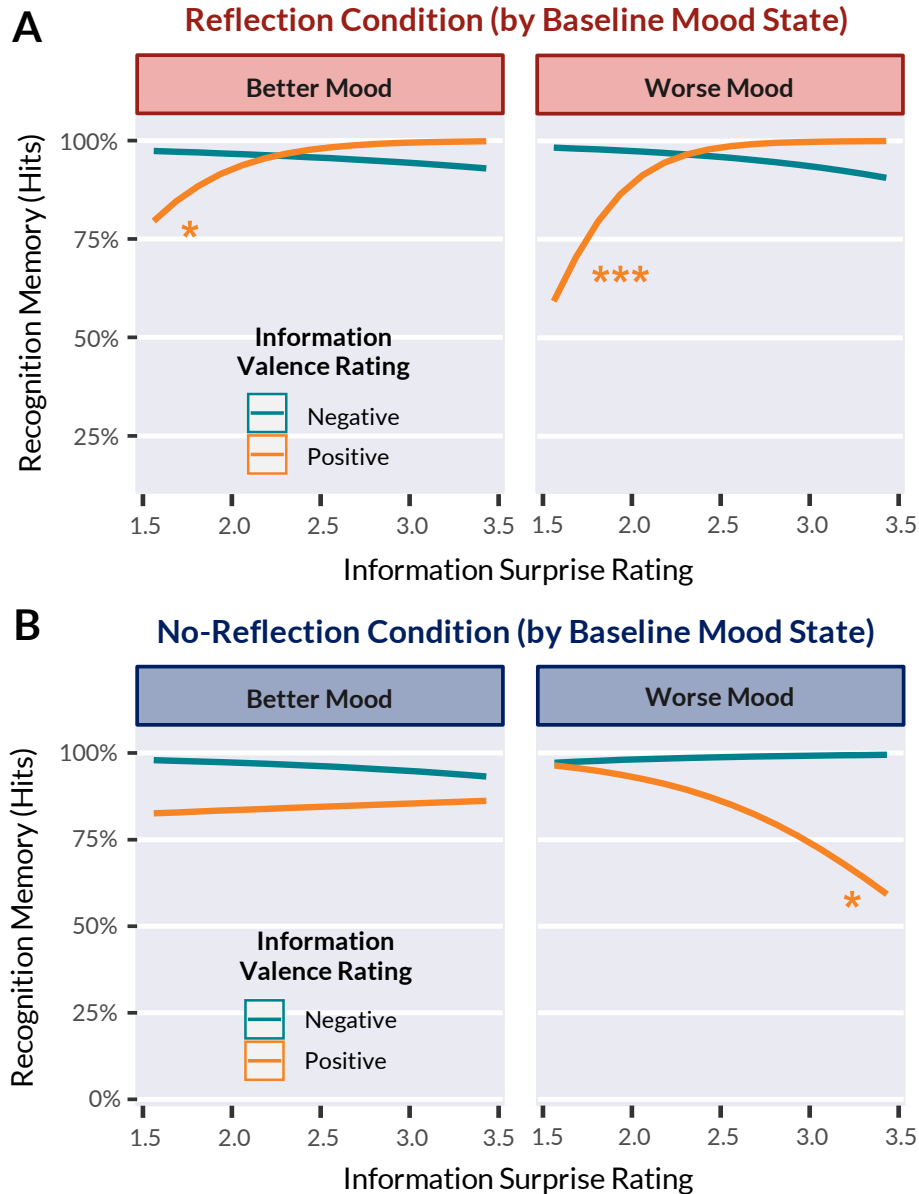
In sum, we found that participants were biased to remember negative information but forget positive information. However, surprise counteracted this negativity bias by boosting memory for positive information. Crucially, this effect was only evident in the Reflection condition, demonstrating that pausing to reflect during information sampling modulated memory. Participants in the No Reflection condition were less likely to remember positive information, and surprise did not counteract this negativity bias. In fact, for No-Reflection participants who were in a negative mood state, surprise actually *decreased* the memorability of positive information, suggesting that information that is incongruent with one's schemas and current mood is more likely to be forgotten. Overall, we found that active reflection during information sampling improved learning, enhanced encoding of surprising positive information, and counteracted a mood-congruent negativity bias.

### Information Valence and Surprisingness Influence Memory



*Figure 3.* Information valence and surprisingness influenced memory outcomes. Lines depict slope estimates from generalized linear mixed-effects models, predicting trial-by-trial memory outcomes while controlling for covariates. Shaded bands indicate 95% confidence intervals around slope estimates. A) Negative information (as rated by an independent sample) was more likely to be remembered than positive information. B) Surprising positive information was more memorable than unsurprising positive information. Negative information was memorable regardless of surprisingness. C) Surprise was associated with better memory for positive information in the Reflection condition, but worse memory for positive information in the No Reflection condition. We propose that pausing to reflect during information consumption changes whether surprising positive information is rejected or encoded. \*\*  $p < .01$ , \*\*\*  $p < .001$

## Reflection Reduced Mood-Congruent Negativity Bias in Memory



*Figure 4.* Reflection reduced the mood-congruent negativity bias in memory. Lines depict slope estimates from generalized linear mixed-effects models, predicting trial-by-trial memory outcomes while controlling for covariates. Shaded bands indicate 95% confidence intervals around slope estimates. A) In the Reflection condition, surprise was associated with better memory for positive information. This memory benefit applied regardless of baseline mood state. B) In the No Reflection condition, participants who began the task in a negative mood state showed a stronger negativity bias in memory, driven by worse memory for surprising positive information. \*  $p < .05$ , \*\*\*  $p < .001$

## **Discussion**

We investigated naturalistic information seeking and memory during an acute global crisis: the early phase of the COVID-19 pandemic (April 2020). Participants were biased to remember negative information and forget positive information, especially if they were in a negative mood state during encoding. However, a simple intervention—asking individuals to pause and reflect on how information made them feel—counteracted this negativity bias by enhancing memory for positive information, especially when that information was surprising. We propose that reflection helps mitigate the impact of negative news by restoring the balance between positive and negative information in memory.

### **Information Seeking**

Participants freely explored a “Virtual Newsroom” where they could sample information from four categories: Statistics, Entertainment, Preparation, and Social information. Overall, participants in the Reflection condition sampled less information than participants in the No-Reflection condition, likely because Reflection condition were required to answer additional questions. Across conditions, participants were more likely to sample information from the Statistics category relative to the Social category. Lastly, we found that the valence of information viewed (determined through ratings from an independent sample) in the Reflection condition was slightly more positive than the information viewed in the No Reflection condition. Overall, while reflection reduced total information sampling, it did not substantially alter the type of information sought. Participants sampled information from all categories, suggesting little avoidance for specific types of information.



## Memory Performance

Overall, recognition memory for Newsroom information was better in the Reflection condition than in the No Reflection condition. Pausing to reflect during information consumption enhanced subsequent memory for that information, aligning with prior evidence that engaging in deeper processing during encoding enhances subsequent memory ( Craik, 2002; Craik & Lockhart, 1972). Importantly, our memory analyses controlled for reading time, number of exposures, overall information load (i.e., total number of information pieces sampled), information category, and confidence ratings provided during the memory test. Therefore, the memory benefits observed in the Reflection condition cannot be explained by time spent encoding or the quantity of interfering information.

In line with prior studies, we found that information valence influenced memory (Kensinger, 2004; Kensinger et al., 2004; Mickley & Kensinger, 2008; Rouhani & Niv, 2019). Participants were biased to remember negative information and forget positive information. However, this negativity bias depended on *surprise*, *reflection*, and *mood*. First, *surprise* enhanced memory by selectively boosting memory for positive information; negative information was memorable regardless of surprise. Second, *reflection* changed the effect of valence and surprise on memory. In the No-Reflection condition, participants were more likely to *forget* surprising positive information, whereas in the Reflection condition, participants were more likely to *remember* surprising positive information. Third, these memory effects depended on *mood*. The negativity bias in memory was exacerbated among participants in the No-Reflection condition who began the task in a negative mood state, consistent with prior studies of mood-congruent memory (Bower, 1981; Faul & LaBar, 2022; Mineka & Nugent, 1995). However, this mood-congruent bias was reduced in the Reflection condition. These mood-

congruent memory effects relate to prior evidence that individuals with depressive symptoms are biased to remember surprising negative information, whereas individuals without depressive symptoms are biased to remember surprising positive information (Rouhani & Niv, 2019).

Beyond negativity biases, our findings contribute to the literature on surprise, expectation, and memory. Encountering new information about familiar topics leads individuals to draw on *schemas* developed through prior experiences (Bartlett, 1995). Schema-inconsistent information is surprising and has been shown to sometimes result in better memory (Rojahn & Pettigrew, 1992; van Kesteren et al., 2012), aligning with other evidence that surprise and novelty enhance memory (Schomaker & Meeter, 2015; Sinclair & Barense, 2019; van Kesteren et al., 2012). However, in other cases, schema-inconsistent information is more likely to be forgotten (Crocker, 1981; Rojahn & Pettigrew, 1992). One factor that may impact whether schema-inconsistent information is remembered or forgotten is how individuals *process* the information. We found that during uninterrupted information seeking (No-Reflection), participants were less likely to remember surprising positive information, aligning with evidence that schema-inconsistent information is often forgotten. In contrast, participants in the Reflection condition were more likely to *remember* surprising positive information, aligning with evidence that surprising and schema-inconsistent information can be memorable. Our findings suggest that reflection changes whether schema-inconsistent information is remembered or forgotten, perhaps by promoting deeper processing during encoding ( Craik & Lockhart, 1972).

Overall, we found that participants were biased to remember negative information and forget positive information, especially if they were in a negative mood state. Without intervention, participants were especially likely to forget *surprising* positive information, suggesting that information that is incompatible with one's schemas and current mood state is

more likely to be forgotten. However, when participants paused to reflect on how information made them feel, surprise instead strengthened memory for positive information. Reflection thus reduced the negativity bias in memory.

### **Limitations and Future Directions**

Prior intervention studies have shown that mindfulness training and relaxation exercises protect against negative affect from negative news (Bazán et al., 2021; Yang et al., 2023). In the present study, we focused on memory outcomes. A key goal for future research is to test whether active reflection influences affect experienced while reading or recalling negative information. Furthermore, future studies could test longer-term interventions to encourage active reflection in daily news consumption. In a longitudinal study, collecting additional mental health measures would offer insight into the potential longer-term benefits of active reflection during information consumption. Furthermore, although our naturalistic Newsroom paradigm included a variety of up-to-date news articles, our stimuli were limited in scope relative to the quantity of information available in real online news sources or social media feeds.

Information seeking and memory are also influenced by beliefs and attitudes (e.g., confirmation bias). In later stages of the COVID-19 pandemic, substantial partisan differences emerged in COVID-19 information consumption and beliefs (Havey, 2020; Imhoff & Lamberty, 2020; Pennycook et al., 2022; Rao et al., 2021; Stanley et al., 2020). Data collection for our study occurred during the very early stage of the pandemic, before this political divide deepened. As a result, our findings may not generalize to highly-polarized news topics.

### **Implications**

Our results bear implications for information consumption and mental health in daily life.

News sources are often inundated with negative information, which captures attention and increases engagement (Robertson et al., 2023). Social media news feeds can promote endless information consumption (“doom-scrolling”) without pauses for reflection. This negativity bias is particularly salient during times of crisis, such as during pandemics, climate change, natural disasters, war, or political unrest. Constant exposure to negative information may negatively impact mental health and make it more difficult for individuals to discover solutions to problems. For example, an individual in isolation due to COVID-19 might ruminate on information about health risks and loneliness instead of seeking information about new ways to find social connection. Likewise, an individual who is concerned about climate change might ruminate on negative information and despair instead of taking action. We offer a simple strategy to ensure that positive information is not forgotten amongst the negative information—pausing to reflect on how information makes you feel. A key benefit of our intervention is its simplicity and relatively low mental effort; this intervention could be readily applied to real-world settings like social media newsfeeds. Future studies could expand on this task design to test strategies for prompting reflection in applied social media contexts.

## **Conclusion**

Overall, we found that active reflection during information sampling enhanced memory, particularly for surprising positive information. Participants who did not pause to reflect—particularly if they were in a negative mood state—were biased to remember negative information and forget positive information. Both news content and cognitive processes are biased to prioritize negative information, which can be detrimental for mental health. We show that active reflection can counteract this negativity bias by enhancing memory for positive information, restoring balance in memory.

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