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Research Report

Perceived self and social relevance of content motivates news sharing across cultures and topics

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Abstract

Well-informed individual and collective decision-making is aided by access to high-quality, factual information. What motivates people to share high-quality news, and how can these motives be leveraged to promote news sharing? Based on the theory that self-related and social motives encourage sharing behavior, we designed and tested interventions to increase news sharing. In the interventions, individuals were exposed to actual news stories and were prompted to identify why the content was relevant to themselves (self-relevance) or people they know (social relevance). Across four studies ($N_{participants} = 2{,}559$, $N_{observations} = 18{,}780$), we systematically examined the effectiveness of these interventions, their generalizability across news topics (climate change and health) and cultures (the United States of America and the Netherlands), their translation to more naturalistic contexts, and their underlying neuropsychological mechanisms. In all studies, we observed expected positive correlations among perceived self and social relevance and sharing intentions. In a neuroimaging study, we also observed corresponding increases in activity in self-referential and social cognitive brain regions. Using the content-framing interventions to test causal relationships, we found that the interventions increased sharing intentions and behavior. Furthermore, we observed generalizability across news topics and cultural contexts and translation to an ecologically valid news exposure context. These findings advance theory by adding neural and behavioral evidence that self-related and social motives prompt people to share information, and demonstrate the ability of content-framing interventions to harness these motives to encourage high-quality news sharing.

Keywords: news, sharing, social media, intervention, fMRI

Significance Statement

The information people are exposed to shapes their attitudes, beliefs, and behavior. Thus, the quality of the information being shared in social networks has important implications for the health and well-being of individuals and societies. Given the detrimental effects of low-quality (false, inaccurate, or misleading) information, it is important to understand what makes accurate, high-quality information spread. Using neural and behavioral experiments, we identify key mechanisms that motivate people to share high-quality news and leverage them to design easily scalable interventions that work in real online environments, for different types of content, and across different populations. Overall, our findings help explain why people decide to share and how to more effectively design interventions to promote sharing of high-quality information.

Competing Interest: The authors declare no competing interests.
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Table 1. Overview of studies.

Study	N	Study design	Intervention design	Topic	Self and social motive DVs	Sharing DVs
1[a]	1613	Online experiment	Between-person	Climate	Self and social relevance	Broad- and narrowcast intentions
2	448	Online field experiment	Within-person	Climate and health	Self and social relevance	Broad- and narrowcast intentions and behavior
3[a]	85	Cross-cultural fMRI experiment	Within-person	Climate and health	Self and social relevance, self and social ROIs	Narrowcast intentions
4	413	Online experiment	Mixed	Climate and health	Self and social relevance	Broad- and narrowcast intentions

[a]Study preregistered prior to data collection.
DVs, dependent variables; ROIs, brain regions of interest; Broadcast intention, intention to share with a large audience on social media; Narrowcast intention, intention to share directly with someone (e.g. via email or direct message).

Introduction

The ability of individuals to make well-informed decisions and work together effectively toward prosocial goals, like combating climate change or supporting community health, depends in part on access to high-quality, accurate information. Indeed, the abundance of low-quality information that contains false, inaccurate, or misleading claims circulating on social media presents a serious threat to public health and societal functioning (1–4). Given that people are increasingly using social media to receive news and information (5), it is critical to understand how to increase the quality of information that is transmitted through social networks. Recent research has identified several promising interventions to decrease the spread of low-quality information (6–9). Another approach to raising the overall quality of the information available is to increase sharing of high-quality information. However, scalable, evidence-based interventions with this goal have not yet been developed. Our work aims to fill this gap by developing theory-based interventions that promote the sharing of high-quality news about societally relevant topics, such as health and climate change.

These interventions are rooted in the value-based framework of sharing, which theorizes that sharing is a value-based decision in which people implicitly and explicitly weigh the costs and benefits of sharing and are more likely to share content if they expect it to lead to positive outcomes (10, 11). Because people tend to assign positive value to their self-concepts (12–14) and to holding positive relations with others (15–18), the self-related and social motives are expected to influence how valuable the act of sharing will be. Empirically, when people perceive information as more relevant to themselves (self-relevance) and to others (social relevance), or consider how it might help them connect with others, they are more motivated to share (19–22). In addition, when messages evoke greater activity in brain regions associated with self-referential processing, social cognition, and valuation, they are more likely to be shared at scale (23–26). Thus, the self and social relevance of information are two potential intervention targets to promote the sharing of high-quality news. In prior work, we designed content-framing interventions targeting self and social relevance and found initial evidence that they increased intentions to share high-quality news articles about climate change and COVID-19 (21). While promising, these initial findings need to be replicated and extended to examine generalizability, test underlying mechanisms, and assess more distal effects beyond news sharing. Doing so will advance our understanding of how content-framing interventions can promote high-quality news sharing.

Current research

The present research builds on these prior findings to systematically test these interventions' (i) effectiveness, (ii) generalizability across news topics and cultural contexts, (iii) translation to naturalistic online environments, (iv) neuropsychological mechanisms, and (v) downstream influences on attitudes and behavior. We adopt a multimethod approach using large-scale online experimental techniques, an online field study, and cross-cultural functional magnetic resonance imaging (fMRI) to achieve these goals across four studies ($N_{participants} = 2{,}559$, $N_{observations} = 18{,}780$; Table 1).

Study 1 extends the initial within-person intervention (21) to test its ability to increase climate news sharing among individuals who are exposed to a single intervention condition and also measures potential downstream intervention-related effects on climate-related beliefs, attitudes, and behavior. Participants were randomly assigned to a "self-focused" intervention group targeting self-relevance, an "other-focused" intervention group targeting social relevance, or a no-intervention control group (Fig. 1), and completed an online survey. All participants were exposed to news headlines and ledes and rated how self and socially relevant they found each article, and their intentions to share the articles on social media and directly with people (e.g. via email or direct message). Participants in the self- and other-focused interventions also wrote brief comments for each article as if they were posting on social media describing why each article was relevant to themselves (self-focused) or people they know (other-focused). Preregistered analyses (https://osf.io/7by85) tested the degree to which the self- and other-focused interventions causally increased the perceived relevance of climate news and intentions to share, as well as correlational relationships between relevance and sharing across the groups. Exploratory analyses also assessed the impact of the interventions on perceived climate knowledge, self-efficacy, climate petition sharing, and perceived impact of individual climate actions, such as driving less and eating less meat, and collective climate actions, such as contacting representatives, donating, and volunteering.

Study 2 extended these findings to a more ecologically valid context via an online field study. Rather than being exposed to headlines and ledes in an online survey, participants were presented with entire news articles using a browser plugin on a platform that resembled how they might encounter news content naturally online and allowed them to actually share the articles. To maximize power, this study was conducted using a within-person design; participants experienced both content-framing interventions, as well as an active control in which they wrote comments describing what the article was about. In addition to

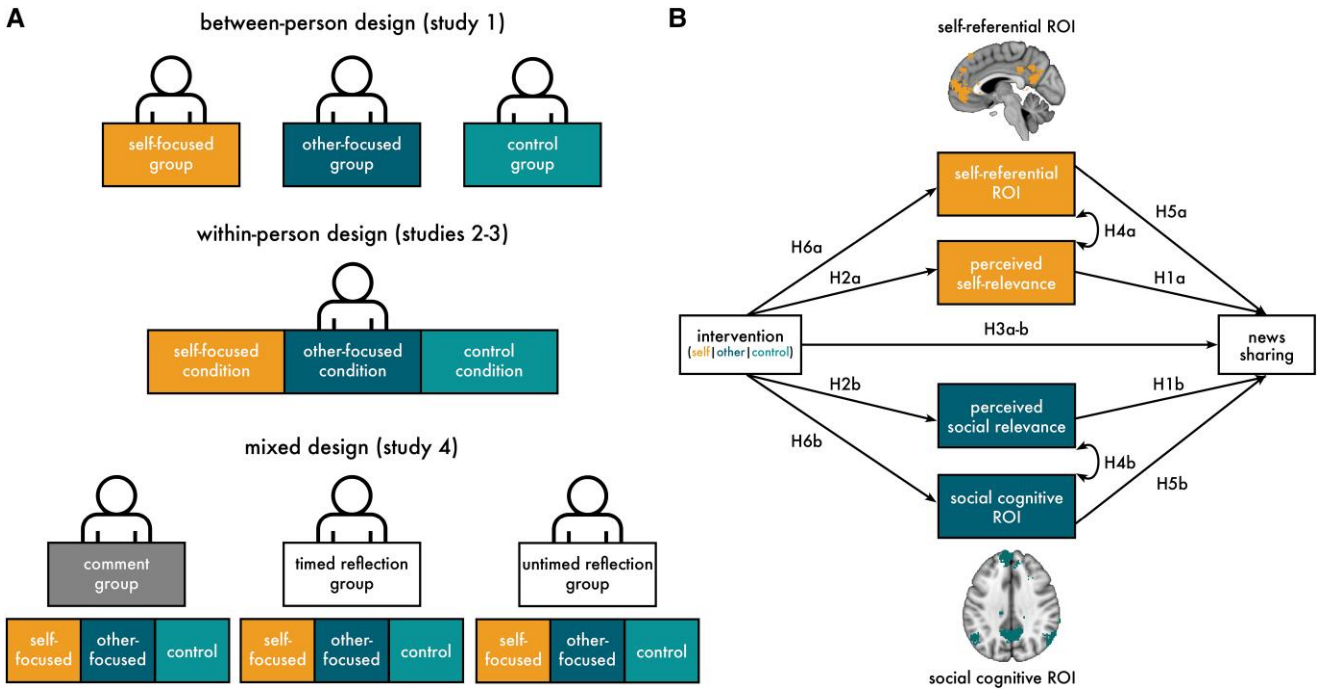

Fig. 1. Study experimental design and conceptual model outlining hypotheses. A) Study 1 used a between-person design in which participants were randomly assigned to either the self- or other-focused intervention groups or a control group that completed no intervention. Studies 2 and 3 used within-person designs in which participants experienced all intervention conditions. Study 4 used the same design as studies 2 and 3 but included an additional between-person manipulation of the type of reflection (writing comments or reflecting only) and amount of time allocated (12 s vs. unlimited time). B) Perceived relevance and brain activity in ROIs are expected to be positively correlated (H4a, b) and each of these indicators of self and social motives are expected to be positively correlated with news sharing intentions and/or behavior (H1a, b, H5a, b). Relative to a control, the content-framing interventions are expected to increase each of the self and social motive indicators (H2a, b, H6a, b) and news sharing intentions and/or behavior (H3).

news articles about climate change, participants also viewed articles about general health topics. Participants rated the articles on the same dimensions as in study 1 and also had the opportunity to share them on Facebook, Reddit, LinkedIn, Twitter, or via email. We extended the analyses in study 1 to examine relationships with sharing behavior and explore potential differences between climate and health news.

Study 3 used fMRI to test the neuropsychological mechanisms underlying sharing decisions across two Western cultures. American and Dutch participants completed a similar within-person content-framing intervention as in study 2 but due to the limitations of the MRI environment, they only reflected on the intervention prompts rather than writing comments in response to them. In preregistered analyses (https://osf.io/2d35g), we tested correlational and causal relationships among perceived self and social relevance, activity in brain regions associated with self-referential processing and social cognition, and intentions to share the news articles. We also examined whether these self-reported and brain indices explained unique variance in news sharing intentions, and explored the degree to which these relationships differed across cultures and news topics. We focused on these a priori brain regions of interest (ROIs) that, relative to other processes, tend to be more strongly activated during self and social thought (27–29) because we expected them to be sensitive to engagement of self and social motives, but complemented these ROI analyses with whole-brain analyses to detect relative differences among intervention conditions in other brain regions.

Because we found that the content-framing interventions were less effective when participants merely reflected on the self and social relevance of news articles in study 3, study 4 examined how different factors affecting engagement (reflecting or writing comments, and the amount of reflection time allowed) impacted intervention effectiveness. Specifically, study 4 used the same within-person designs in studies 2 and 3, but included an additional between-person manipulation of the type of reflection (writing comments or reflecting only) and amount of time allocated (12 s vs. unlimited time).

Hypotheses

H1. Greater (a) self-relevance and (b) social relevance ratings will be associated with stronger news sharing intentions and behavior.

H2. Compared with the control condition, the (a) self-focused condition will increase self-relevance ratings and (b) other-focused condition will increase social relevance ratings.

H3. Compared with the control condition, the (a) self-focused and (b) other-focused conditions will increase news sharing intentions and behavior.

H4. Greater activity in the (a) self-referential ROI will be associated with higher self-relevance ratings and (b) greater activity in the social cognitive ROI will be associated with higher social relevance ratings.

H5. Greater activity in the (a) self-referential and (b) social cognitive ROIs will be associated with stronger news sharing intentions.

H6. Compared with the control condition, the (a) self-focused condition will increase activity in the self-referential ROI and the (b) other-focused condition will increase activity in the social cognitive ROI.

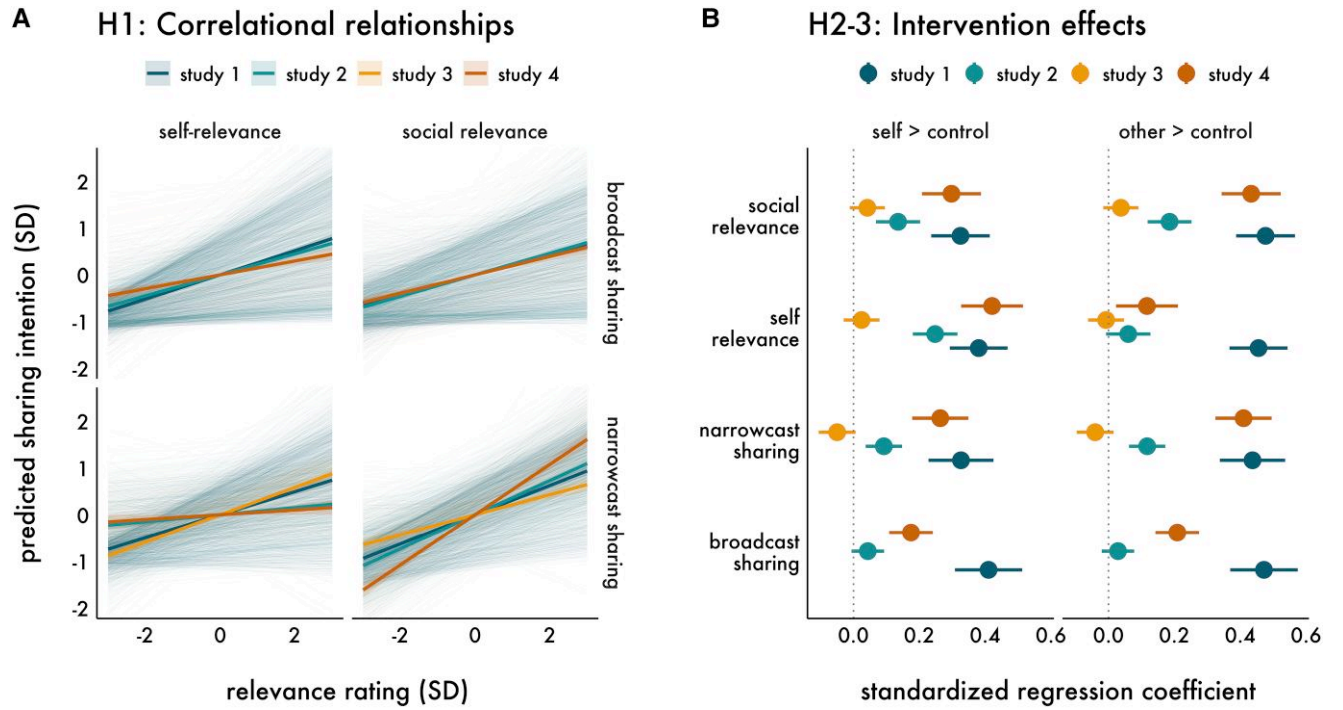

Fig. 2. Results from the models testing hypotheses H1–3. A) Correlational relationships between self and social relevance (x-axis) and intentions to share news articles (y-axis) broadly on social media ("broadcast sharing"; top panel) and directly with people e.g. via email or direct message ("narrowcast sharing"; bottom panel). Across all four studies, there are unique, positive correlational relationships among these variables. Model predicted values are overlaid on individual predicted slopes. Error bands are 95% CI. B) Intervention effects (x-axis) of the content-framing interventions on self-relevance, social relevance, broad- and narrowcast sharing intentions (y-axis) for the self-focused intervention (left panel) and the other-focused intervention (right panel) vs. the control condition or group. The largest effects tended to be in the online experiments using between-person (study 1) and within-person (study 4) designs, whereas the online field study interventions (study 2) showed more modest effects and the MRI-adapted interventions without the writing component (study 3) were not effective. The dotted line at zero represents no difference between the intervention and control condition; estimates >0 indicate positive intervention effects. Error bars are 95% CI. Results from study 4 are from the comment group only.

Results

H1: Self and social relevance are positively correlated with news sharing

First, we sought to replicate prior findings indicating that perceptions of the self and social relevance of information are positively correlated with intentions to share (21). Across all studies, we found convergent evidence that when participants perceived news articles as more self and socially relevant, they also reported stronger intentions to share the articles (Fig. 2, Table 2). Joint estimates across studies for the relationship between self-relevance and sharing are as follows: $\beta = 0.23$, 95% CI [0.21, 0.25], $t(905.59) = 20.28$, $P < 0.001$ for broadcast sharing and $\beta = 0.19$, 95% CI [0.17, 0.22], $t(753.60) = 16.51$, $P < 0.001$ for narrowcast sharing. Joint estimates across studies for the relationship between social relevance and sharing are as follows: $\beta = 0.21$, 95% CI [0.19, 0.23], $t(948.80) = 18.40$, $P < 0.001$ for broadcast sharing and $\beta = 0.36$, 95% CI [0.33, 0.38], $t(858.57) = 29.35$, $P < 0.001$ for narrowcast sharing. Furthermore, in the study 2 field experiment, greater perceived social relevance, but not self-relevance, was associated with an increased likelihood of actual sharing behavior.

H2: Content-framing interventions increase perceived news relevance when people engage

Next, we sought to confirm that the content-framing interventions causally influence their intended targets. As expected, in studies 1, 2, and 4, we found that relative to a control condition, the self-focused framing intervention increased the perceived self-relevance of news articles and the other-focused framing intervention increased perceived social relevance (Table 2). However, when participants completed a version of the content-framing interventions adapted for the MRI scanner—in which they were instructed to reflect on relevance but did not write comments—neither intervention increased perceptions of relevance compared with the control condition. Given these results, study 4 examined how different factors affecting engagement (reflecting vs. writing comments, and the amount of reflection time allowed—12 s vs. unlimited time) impacted intervention effectiveness. Consistent with the findings from the prior studies, participants who were randomly assigned to complete the content-framing interventions by writing comments (as in studies 1 and 2) rated health and climate news articles are more self and socially relevant and reported higher intentions to share them compared with participants who reflected by did not write comments (as in study 3; results are reported in Table S18). Consistent with the idea that deeper engagement (e.g. through writing) is necessary for the content-framing interventions to work, we found that writing longer comments was associated with higher perception of self and social relevance, as well as news sharing intentions in studies 1, 2, and 4 (Table S4).

Joint estimates for the relationship between the content-framing interventions and self-relevance across studies in which participants wrote comments (studies 1, 2, and 4) are as follows: $\beta = 0.33$, 95% CI [0.29, 0.38], $t(11{,}755.30) = 14.73$, $P < 0.001$ for the self-focused intervention and $\beta = 0.17$, 95% CI [0.12, 0.21],

Table 2. Results from models testing hypotheses H1–3.

Dependent variable	Parameter	β [95% CI]			
		Study 1	Study 2	Study 3	Study 4
H1a-b: Broadcast sharing intention	Self-relevance	**0.26 [0.23, 0.29]**	**0.22 [0.19, 0.26]**	—	**0.15 [0.10, 0.19]**
	Social relevance	**0.21 [0.18, 0.24]**	**0.23 [0.20, 0.26]**	—	**0.20 [0.15, 0.24]**
H1a-b: Narrowcast sharing intention	self-relevance	**0.25 [0.21, 0.28]**	**0.08 [0.04, 0.11]**	**0.29 [0.26, 0.33]**	**0.05 [0.00, 0.10]**
	Social relevance	**0.31 [0.28, 0.35]**	**0.37 [0.33, 0.40]**	**0.22 [0.17, 0.26]**	**0.54 [0.49, 0.59]**
H1a-b: Sharing behavior	Self-relevance	—	0.04 [−0.68, 0.76]	—	—
	Social relevance	—	**1.01 [0.06, 1.96]**	—	—
H2a: Self-relevance	Other-control	**0.46 [0.37, 0.54]**	0.06 [−0.01, 0.13]	−0.01 [−0.06, 0.05]	**0.12 [0.02, 0.21]**
	Self-control	**0.38 [0.29, 0.47]**	**0.25 [0.18, 0.32]**	0.02 [−0.03, 0.08]	**0.42 [0.33, 0.51]**
H2b: Social relevance	Other-control	**0.48 [0.39, 0.57]**	**0.19 [0.12, 0.25]**	0.04 [−0.02, 0.09]	**0.43 [0.34, 0.52]**
	Self-control	**0.32 [0.24, 0.41]**	**0.14 [0.07, 0.20]**	0.04 [−0.01, 0.10]	**0.30 [0.21, 0.39]**
H3: Broadcast sharing intention	Other-control	**0.47 [0.37, 0.57]**	0.03 [−0.02, 0.08]	—	**0.21 [0.14, 0.28]**
	Self-control	**0.41 [0.31, 0.51]**	0.04 [−0.01, 0.09]	—	**0.17 [0.11, 0.24]**
H3: Narrowcast sharing intention	Other-control	**0.44 [0.34, 0.54]**	**0.12 [0.06, 0.17]**	−0.04 [−0.10, 0.02]	**0.41 [0.32, 0.50]**
	Self-control	**0.33 [0.23, 0.42]**	**0.09 [0.04, 0.15]**	−0.05 [−0.11, 0.01]	**0.26 [0.18, 0.35]**
H3: Sharing behavior	Other-control	—	0.71 [−0.54, 1.97]	—	—
	Self-control	—	**1.45 [0.25, 2.65]**	—	—

Parameter estimates for models with sharing behavior as the DV are log odds. All statistics from each model is reported in Supplementary material. Results from study 4 are from the comment group only. Statistically significant ($P < 0.05$) relationships are bolded.

$t(11{,}784.77) = 7.50$, $P < 0.001$ for the other-focused intervention. Joint estimates across these studies for relationship between the content-framing interventions and social relevance are as follows: $\beta = 0.22$, 95% CI [0.18, 0.27], $t(11{,}993.83) = 10.00$, $P < 0.001$ for the self-focused intervention and $\beta = 0.31$, 95% CI [0.27, 0.35], $t(12{,}017.22) = 13.94$, $P < 0.001$ for the other-focused intervention.

H3: Content-framing interventions increase news sharing when people engage

We next extended the correlational analyses testing hypothesis H1 to examine the causal relationships between relevance and sharing (Table 2). Participants who were randomized to either the self- or other-focused intervention groups in study 1 reported higher intentions to share news articles about climate change compared with a between-person control group. These effects are mirrored in study 2, which used a within-person design and exposed participants to full articles in a more naturalistic environment. When participants were prompted to describe why the articles were relevant to themselves (self-focused condition) or people they know (other-focused condition), they reported higher intentions to share them compared with when they described what the articles were about. Furthermore, identifying why the articles were relevant to themselves increased the probability of actually sharing the articles on social media or via email. In study 3, we found additional evidence that the MRI-adapted version of the content-framing interventions (without a writing component) was not effective; neither the self- nor other-focused interventions increased intentions to share the news articles. Post hoc exploratory analyses reported in Supplementary material explore individual differences in intervention effectiveness in study 3. Joint estimates for the relationship between the self-focused intervention and sharing across studies in which participants wrote comments (studies 1, 2, and 4) are as follows: $\beta = 0.13$, 95% CI [0.09, 0.16], $t(12{,}496.20) = 6.98$, $P < 0.001$ for broadcast sharing and $\beta = 0.18$, 95% CI [0.14, 0.22], $t(12{,}661.91) = 8.77$, $P < 0.001$ for narrowcast sharing. Joint estimates for the relationship between the other-focused intervention and sharing in these studies are as follows: $\beta = 0.13$, 95% CI [0.10, 0.17], $t(12{,}489.43) = 7.23$, $P < 0.001$ for broadcast sharing and $\beta = 0.24$, 95% CI [0.20, 0.28], $t(12{,}661.68) = 12.05$, $P < 0.001$ for narrowcast sharing.

We also tested the degree to which intervention-related effects on sharing were mediated by self and social relevance in supplementary analyses. In studies with the strongest intervention-related effects (studies 1 and 4), we generally replicated our prior research (21) showing dual pathways through self and social relevance (Tables S10 and S11). In studies with weaker effects (studies 2–3), we did not generally observe evidence of mediation.

H4: Activity in self and social brain regions is positively correlated with perceived news relevance

Study 3 examined the neuropsychological mechanisms underlying decisions to share high-quality news using functional neuroimaging. In preregistered ROI analyses, we found that stronger activity in the self-referential ROI was positively correlated with self-reported perceptions of the self-relevance of the news articles (Table 3). In parallel, stronger activity in the social cognition ROI was positively correlated with self-reported perceptions of social relevance. This suggests that both self-reported perceptions and functional brain activation are sensitive to self-related and social motivations to share. In conjunction with the whole-brain analyses, sensitivity analyses reported in Supplementary material using a set of "control" regions in auditory cortex not expected to be sensitive to self and social motives demonstrate that these relationships are not generalized across the whole brain (Table S14).

H5: Activity in self and social brain regions is positively correlated with news sharing intentions

Although the MRI-adapted reflection-only content-framing interventions were not as effective as the writing interventions in studies 1 and 2, we observed correlational evidence that is consistent with the hypothesis that self and social motives influence sharing. Replicating prior findings (26, 30) we found that stronger activity in brain regions implicated in self-referential processing and social cognition during news exposure was associated with higher intentions to share the news articles (Table 3). Furthermore, compared with models that included either self-reported relevance (H1) or ROI activity (H5) alone, combining self-reported and brain indices improved model fit in both the self and social models (Table S16). In these combined models, all variables remained

Table 3. Results from study 3 models testing hypotheses H4–6.

Dependent variable	Term	β [95% CI]	df	t	P
H4a: Self-relevance	Intercept	−0.01 [−0.08, 0.07]	84.10	−0.20	0.841
	Self-referential ROI	**0.05 [0.02, 0.07]**	**82.76**	**3.68**	**<0.001**
H4b: Social relevance	Intercept	−0.02 [−0.10, 0.07]	84.49	−0.41	0.685
	Social cognitive ROI	**0.05 [0.02, 0.08]**	**83.18**	**3.80**	**<0.001**
H5a: Narrowcast sharing intention	Intercept	−0.01 [−0.08, 0.06]	84.43	−0.27	0.791
	Self-referential ROI	**0.08 [0.05, 0.11]**	**81.64**	**6.11**	**<0.001**
H5b: Narrowcast sharing intention	Intercept	−0.02 [−0.10, 0.05]	85.39	−0.66	0.511
	Social cognitive ROI	**0.07 [0.05, 0.10]**	**81.87**	**5.48**	**<0.001**
H6a: Self-referential ROI	Intercept (control)	0.08 [−0.03, 0.20]	84.07	1.46	0.147
	Other-control	**0.09 [0.01, 0.16]**	**83.53**	**2.19**	**0.032**
	Self-control	**0.09 [0.00, 0.17]**	**83.67**	**2.06**	**0.043**
H6b: Social cognitive ROI	Intercept (control)	0.33 [0.22, 0.44]	84.10	5.93	<0.001
	Other-control	0.06 [−0.02, 0.14]	83.34	1.58	0.117
	Self-control	0.07 [−0.01, 0.16]	83.73	1.72	0.089

Degrees of freedom were calculated using the Satterthwaite approximation. Statistically significant ($P < 0.05$) relationships of interest are bolded.

statistically significant predictors of news sharing, demonstrating that they are complementary indices of self and social motives that account for unique variance (Table S17).

H6: Content-framing interventions increase activity in self-referential brain regions

Examining the causal effects of the content-framing interventions on brain activity, we found that both the self- and other-focused interventions increased activity in brain regions associated with self-referential processing (Table 3). We found directional increases for both content-framing interventions in brain regions associated with social cognition, but these increases were not statistically significant. Whole-brain analyses reported in Supplementary material indicated that both the self- and other-focused interventions increased activation in precuneus and posterior cingulate cortex, which are key nodes in the self and social processing systems (27–29).

Exploratory analyses

In order for the content-framing interventions to be useful tools to increase sharing of high-quality news, they should generalize in various ways. The following exploratory analyses assess the degree to which the hypothesized relationships tested in H1–6 generalize across news topic (health or climate news) and cultural context (United States of America or the Netherlands). We also examine whether these interventions have downstream impacts on climate-related beliefs, attitudes, and behaviors. For simplicity, we describe the results in the main manuscript and report detailed statistics in Supplementary material.

News topic: causal effects tend to be consistent across climate and heath news

We explored the degree to which the correlational and causal relationships testing H1–6 were moderated by article topic (climate or health) in studies 2, 3, and 4 (comment group only). Study 1 was not included in this analysis because all news stimuli pertained to climate. Overall, we found that although there are mean-level differences between climate and health news articles in perceptions of relevance, brain activity, and sharing intentions, the content-framing interventions tended to be similarly effective across article topics. Results are reported in Supplementary material (Tables S5 and S6).

Culture: relationships tend to be consistent across American and Dutch samples

Study 3 allowed us to examine the generalizability of the correlational and causal relationships across two cultural contexts—United States of America and the Netherlands—by adding culture as a moderator to the models testing hypotheses H1–6. Overall, the American cohort exhibited greater neural activity in the self-referential and social cognitive ROIs, but there were no other differences between the cohorts (Fig. 3). Although it is possible that these main effects were due to differences in scanning environments between the sites, intervention-related analyses examined differences between conditions within person and therefore cannot be accounted for by such differences. Overall, these analyses provide evidence of proximal generalizability across cultures and suggest that individuals from disparate cultures may consider self and social motives for sharing in similar ways. Results are reported in Supplementary material (Table S7).

Climate action: content-framing interventions have downstream effects on intentions to share petitions and perceived environmental impact of climate actions

Study 1 used a between-subjects design and focused on climate-related news, which afforded the ability to assess the impact of the content-framing interventions on downstream outcomes, such as intentions to share other information or engage in climate action. The results from these analyses are described here and reported in Supplementary material (Tables S8 and S9). We found that both the self- and other-focused interventions' effects were not limited to news sharing. They also affected subsequent willingness to share petitions calling for climate action. Importantly, this finding demonstrates that reflecting on the self and social relevance of news articles can exert a lingering effect that generalizes to increase intentions to share other future content. Beyond sharing, we found that both interventions increased self-perceptions of climate knowledge relative to the control group. Furthermore, the other-focused intervention increased perceived self-efficacy of climate action, as well as the perceived environmental impact across all climate actions assessed. That is, participants who considered why climate news was relevant to people they know subsequently reported higher perceived impact of individual actions such as driving and flying less, eating less meat and more vegetarian and vegan meals, paying for renewable energy, and recycling; and proenvironmental collective actions such as signing petitions, volunteering, contacting

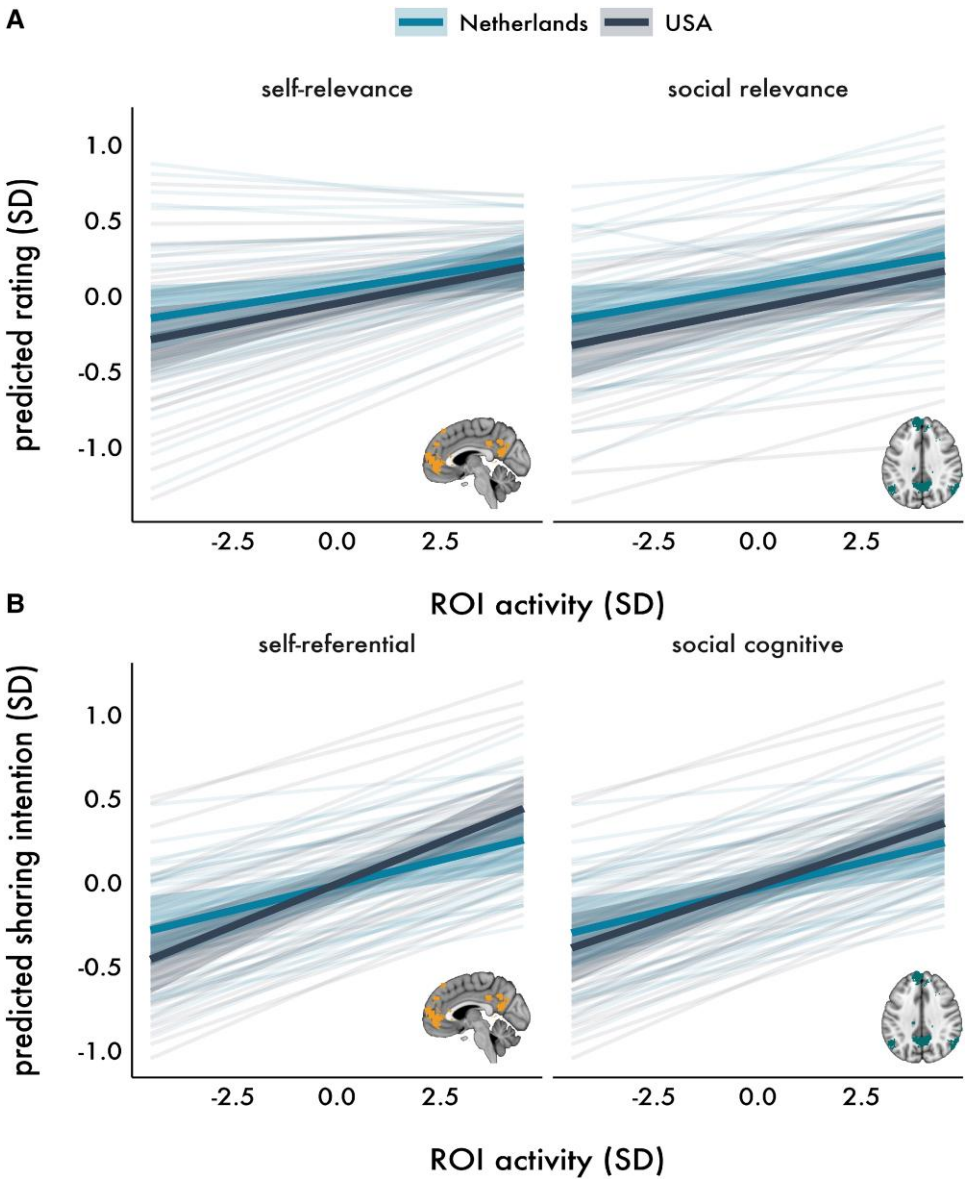

Fig. 3. Results from the cultural comparison analysis. Both the American and Dutch cohorts showed positive relationships between activity in self-referential and social cognitive ROIs and predicted A) self and social relevance ratings and B) sharing intentions, and the magnitude of these associations were similar across cultures. Model predicted values are overlaid on individual predicted slopes. Error bands are 95% CI.

political representatives, donating money, and talking with close others about climate change. Together, these exploratory results suggest that the content-framing interventions not only change how news is perceived but have the potential to shift more distal beliefs, attitudes, and behavior.

Discussion

Neural and behavioral research suggests that self-related and social motives drive information sharing. Drawing on these insights, we tested theory-based content-framing interventions to promote the sharing of high-quality news. Using a combination of experimental, field study, and cross-cultural fMRI methods, we observed robust and replicable evidence that targeting the self and social relevance of news increases willingness to share it. Across four studies, we replicated prior research showing positive associations among self-reported self and social relevance, activity in self-referential and social cognitive brain regions, and sharing intentions. When participants engaged with the intervention by writing prompted comments about the self and social relevance of news articles, the content-framing interventions increased perceptions of news as self and socially relevant, and increased sharing intentions and behavior. These relationships tended to generalize across topics (news articles about climate change and general health topics), across cultures (American and Dutch samples), and settings (laboratory, online, and naturalistic contexts that allowed actual sharing). Furthermore, the content-framing interventions also had downstream effects on intentions to share new information (not targeted in the intervention itself), attitudes, beliefs, and behavioral intentions. Theoretically, these findings add important neural and behavioral evidence that self-related and social motives prompt people to share information. Practically, they demonstrate that these motives can be activated through content-framing interventions to increase the spread of high-quality news. Together, this set of studies constitutes a major step forward in providing diverse practitioners—journalists,

content creators, social activists, and public health officials—with evidence-based tools to influence sharing behavior.

Neuropsychological mechanisms of sharing

In line with theoretical predictions (10, 20), when people perceived content as more self and socially relevant, or the content elicited stronger activity in brain regions associated with self-referential processing and social cognition, people reported stronger sharing intentions. The self-reported and neural measures also explained unique variance in sharing intentions, indicating that they are complementary measures that can be considered in tandem. Together with previous research examining more specific self and social goals (22), self-reported self and social relevance (21), and activity in these brain systems (23–26, 30), these findings provide compelling evidence that self-related and social motives encourage sharing.

These findings advance the value-based framework of sharing, which highlights self-related and social motives as two important sources of value when deciding whether or not to share (10, 11). Whereas previous studies testing this framework have been primarily correlational in nature (10, 23–25, 30), this study adds critical causal evidence for the idea that self-related and social motives—here engaged through active reflection on the self and social relevance of information—encourage sharing and are supported by brain regions implicated in self-referential and social cognitive processes. Parallel mediation analyses showing indirect paths between the content-framing interventions and sharing through both self and social relevance provide convergent evidence for this causal model. These findings increase confidence that targeting these mechanisms can reliably influence high-quality news sharing in new situations and contexts.

They also highlight that self-related and social motives are closely intertwined in the context of sharing. Indeed, the self-focused intervention increased not only the perceived self-relevance of news but also the perceived social relevance. The other-focused intervention also increased the perceived self-relevance of news, albeit to a lesser extent. This demonstrates that while separable, self-related, and social motives are neither fully independent nor mutually exclusive (21, 26). For instance, to present oneself as a valuable member of a social group, it may be beneficial to share self-relevant information about positive traits that the group values. The present results are also consistent with prior research demonstrating that experimentally manipulating self-related and social motives can increase sharing intentions through both self and social relevance simultaneously (21).

Cross-cultural study of news sharing

We explored potential cultural differences in news processing and intervention effectiveness with American and Dutch samples. We did not observe evidence of moderation and the direction of relationships tended to be the same in each sample, suggesting proximal generalizability. This is further supported by a separate analysis of data from these participants showing that neural signals in both samples predicted population-level news sharing metrics (23). Given that the United States of America and the Netherlands are both Western, democratic, wealthy, industrialized countries that have similar but distinct cultural value structures (31), it is important to extend these initial findings to a broader array of cultural contexts. Indeed, the strength of the relationships between self and social relevance and sharing may differ depending on how interdependent or independent a culture tends to be (24). Although cross-cultural fMRI studies are resource intensive and cannot hold scanning environments constant, our work suggests that explicit relevance ratings provide related indicators of self-related and social motives that can be used to study these relationships across cultures.

Translational implications

Translational interventions targeting self and social motives have the potential to increase the sharing of high-quality information, which in turn can shift social norms (32, 33) and catalyze broader attitudinal and behavioral change (34). We found that prompting would-be sharers to identify their own reasons why news was relevant to themselves or others can increase their motivation to share, including in more ecologically valid contexts. This approach to promoting sharing is less labor-intensive and less context-dependent than content tailoring by content creators (e.g. infusing sensationalism into content to make it more "shareable"). Consistent with the idea that self and social motives are fundamental (17) and shape decision-making (35, 36), we also observed promising initial evidence that increasing the perceived self and social relevance of information has broader impacts on individuals. We found that the content-framing interventions affected not only news sharing but also more distal beliefs, attitudes, and behavior related to the content.

For an intervention to be widely useful, it should also generalize in various ways. We found that the content-framing interventions were effective using both within- and between-person designs. They were effective across health and climate change articles and also across the American and Dutch samples. In a more ecologically valid paradigm, the direction of all associations replicated, although the magnitudes were somewhat weaker. Even still, small effects for individuals can have substantial impact at population scales. As information spreads throughout broad social networks, a single act of sharing could have a cumulative impact by reaching many other individuals. This work is a promising initial step toward real-world translation, but iterative refinement of the intervention is necessary to increase its impact in more naturalistic contexts.

Limitations and future directions

Despite notable strengths—preregistration, replication, triangulation across neural, behavioral, and field study methods, the use of actual news stories, and inclusion of multiple cultural contexts—this research should be considered in light of limitations. Although the fMRI study focused on American and Dutch students to explore cross-cultural sharing motivation, the generalizability of results beyond these populations remains unclear. The behavioral studies extended the scope to broader adult samples in the United States of America, but these samples were somewhat less racially and ethnically diverse than the country as a whole. Study 2 provided preliminary evidence that the content-framing interventions increase actual sharing behavior, but given the low base rates of sharing, larger samples in future work are needed to accurately assess the magnitude of intervention-related changes in news sharing. This work focused on the sharing of high-quality news, but future research should investigate the role of self and social motives in the sharing of low-quality news, as these general mechanisms could presumably apply in the latter context as well. If so, future research might examine how reducing the self and social relevance of misinformation might decrease its sharing. Alternatively, future work could examine how self and social motives might be harnessed to reduce the sharing of low-quality information by strengthening

the perception of oneself as someone who shares high-quality information (targeting self-relevance) or the perception that a person's social group cares about the quality of information being shared (targeting social relevance).

Conclusion

Our findings provide robust and replicable evidence that self-related and social concerns motivate sharing and highlight the potential of content-framing interventions to encourage people to share high-quality news. By increasing the quality of information circulating within social networks, individuals and society will be better equipped to make well-informed decisions and cooperate effectively toward shared goals.

Materials and methods

Detailed methods and power analyses for each study are reported in Supplementary material.

Open practices statement

Study 1 (https://osf.io/7by85) and study 3 (https://osf.io/2d35g) were preregistered prior to data collection. Because the study 1 preregistration was originally written for a stand-alone study, we deviated from our preregistered analysis plan in the following ways for simplicity and to enable consistency across studies combined in this manuscript: (i) we fit broadcast and narrowcast sharing models separately (vs. in a combined model with an interaction term for sharing type), (ii) we did not conduct exploratory analyses comparing the self- and other-focused intervention conditions directly, and (iii) we did not disaggregate within- and between-person relationships when testing H1. We deviated from our study 3 preregistration in the following way: to retain mean differences in ROI activity between participants (and therefore enable intercepts to vary randomly across participants), ROI signals were standardized but not mean-centered within-person.

Study 1

Participants

Participants ($N = 1{,}687$) who did not deny the existence of anthropogenic causes of climate change were recruited using the online platform Prolific. Participants were aged 18–88 ($M = 51.6$, SD = 20) and reported the following gender identities: 51.9% women, 45.6% men, 1.4% nonbinary, 0.8% preferred to self-describe, and 0.2% did not report. Participants reported the following racial and ethnic identities: 69.7% White, 14.0% Black or African American, 9.7% Hispanic or Latina/o/x, 5.0% reported more than one race/ethnicity, 4.3% East Asian, 2.3% South Asian, 2.3% Southeast Asian, 0.4% American Indian or Alaskan Native, 0.1% Native Hawaiian, or Other Pacific Islander, 1.3% identified with a race/ethnicity not list, and 0.7% preferred not to say. This study was approved by the University of Pennsylvania Institutional Review Board and all participants gave informed consent. In accordance with the standard operating procedures for this project (described in detail here: https://osf.io/6jufq), participants were excluded if they denied the existence or anthropogenic causes of climate change ($n = 15$), failed two attention checks ($n = 4$), were an outlier in responding invariantly across survey measures ($n = 30$), gave poor-quality written responses ($n = 15$), self-reported data quality issues ($n = 8$, i.e. using ChatGPT or other AI tools for written responses, answering dishonestly, or not taking the study seriously), or more than one of these reasons ($n = 2$). This yielded a final sample of $N = 1{,}613$. We also removed individual responses in which participants did not provide good faith responses, which we defined as writing five or fewer words or being flagged in quality assessment ($n_{responses} = 153$, 1.90% of total responses).

Procedure

Study 1 uses a subset of data from a larger study comparing various psychological interventions to promote climate action (https://osf.io/x9c6j). This project contains other interventions and measures not discussed here. The content-framing interventions were adapted from Cosme et al. (21) to use a between-person design. Participants were randomly assigned to one of the content-framing interventions—self-focused ($N = 392$) or other-focused ($N = 387$)—or a no-intervention control group ($N = 834$). All participants were exposed to five news headlines and ledes about climate change from the New York Times and rated them on the following dimensions: self-relevance ("This message is relevant to me"), social relevance ("This message is relevant to people I know"), broadcast sharing intention, ("I would share this article by posting on social media [on Facebook, Twitter, etc.]"), and narrowcast sharing intention ("I would share this article directly with someone I know [via email, direct message, etc.]"). Ratings were made on a scale from 0 (strongly disagree) to 100 (strongly agree). Participants in the self- and other-focused interventions also wrote brief comments for each article as if they were posting on social media describing why each article was relevant to themselves (self-focused; "Describe why this message matters to you personally") or people they know (other-focused; "Describe why this message matters to people you know"). Each participant viewed five articles randomly selected from a pool of 26 articles.

After completing the content-framing interventions (or no intervention in the control group), participants completed climate action outcome measures and reported demographics. The climate action outcomes reported in this manuscript include petition sharing, perceived environmental impact of climate actions, perceived climate knowledge, and climate self-efficacy. These measures are described in more detail in Supplementary material. Additional measures included in this project are described in the standard operating procedure (https://osf.io/6jufq).

Study 2

Participants

Participants were recruited using Prolific ($N = 522$). Participants were aged 18–78 ($M = 38.07$, SD = 12.28) and reported the following gender identities: 58.6% men, 40.9% women, and 0.003% did not report (no other gender options were provided on Prolific in this field study). Participants reported the following racial and ethnic identities: 70.1% White, 7.6% Asian, 10.7% Black, or African American, 2.4% as another race or ethnicity, 7.6% Biracial, and 1.3% did not report their race. This study was approved by the WCG Institutional Review Board and all participants gave informed consent. Participants were excluded if there were technical issues during their participation, they failed the attention check or did not complete the full study ($n = 52$) or if they did not complete all three conditions at least once in the time allowed ($n = 46$). Participants were excluded if they completed an implausibly high number of trials within the 60 min period, defined as being more than 3 SD from the median ($n = 11$; median = 7, SD = 7.13) resulting in $N = 413$ participants for analysis. We removed individual responses in which participants did not provide good faith responses, which we defined as writing five or fewer

words ($n_{responses} = 200$, 5.2% of total responses). Participants were not recruited or excluded on the basis of beliefs about the cause of climate change.

Procedure

This study used a self-paced, within-person version of the same content-framing interventions from study 1 on a platform designed to resemble a more natural online viewing experience (described in detail in Supplementary material). Each participant completed both the self- and other-focused intervention conditions as well as a control condition in which participants wrote about what the articles were about. Participants viewed news articles about climate change and general health topics from the New York Times and were presented with the entire text of the articles rather than headlines and ledes. Articles were randomly presented from a pool of 96 articles; the news article selection process is described in Supplementary material. After reading the articles and writing comments according to the intervention condition, they made the same ratings as in study 1. Participants also had the opportunity to share articles on Facebook, Reddit, LinkedIn, Email, or Twitter platforms by clicking the appropriate share button.

Study 3

Participants

Participants were recruited from two testing sites, universities in the Netherlands ($n = 40$) and Northeastern United States of America ($n = 45$). Participants were aged 18–31 ($M = 21.4$, $SD = 2.5$) and reported the following gender identities: 48.2% men, 48.2% women, 1.2% nonbinary, 1.2% gender fluid, and 1.2% did not report. Participants reported the following racial and ethnic identities: 48.2% White, 16.5% East Asian, 11.8% Hispanic or Latina/Latino/Latinx, 8.2% Black or African American, 8.2% as another race or ethnicity, 7.1% Biracial, 5.9% South Asian, 2.4% Southeast Asian, and 1.2% preferred not to say, and 2.4% did not report their race or ethnicity. Participants were included if they were fluent in English, right-handed, and a university student or recent graduate. Participants were ineligible if they had any irremovable nonferrous metallic objects (i.e. implanted medical devices) or were currently pregnant or breastfeeding. Participants were also ineligible if they reported a history of substance abuse, major mental health diagnosis, or psychotropic medication use. Participants were not recruited or excluded on the basis of beliefs about the cause of climate change. This study was approved by the Institutional Review Boards at the University of Pennsylvania and the University of Amsterdam, and all participants gave informed consent.

Procedure

Participants were recruited as part of a larger project on news sharing (23) that included additional tasks and measures not considered in this manuscript (see project information online: https://osf.io/caxfq). After being enrolled in the study but prior to completing the MRI session, participants completed an online survey assessing various individual differences measures (https://osf.io/5hps4). At the MRI session, participants were trained and then completed an incentive-compatible version of the content-framing intervention task inside the MRI machine. This study used a within-person design similar to study 2—each participant engaged in the self- and other-focused interventions and the control condition during the task. Participants viewed a random subset of 72 articles from the 96-article stimulus set used in study 2 and reflected on the articles according to the intervention condition for 12 s. Due to the constraints of the MRI machine, participants only reflected but did not write comments as in studies 1 and 2. After reflecting, participants rated their intention to share the article with a person they identified prior to the task. After the MRI scan, they completed a post-scan rating task (described below). After the in-person session, participants were asked to share a randomly selected article they rated as being willing to share. Detailed methods about the task, neuroimaging acquisition, preprocess, analysis, ROI definition, and sensitivity analyses using alternatively defined ROIs are provided in Supplementary material.

Study 4

Participants

This online study was conducted through Prolific. Participants were included if they were adults 18 or older, residing in the United States of America, fluent in English, and passed an initial attention test ($N = 505$). Participants were excluded if they failed the attention check ($n = 0$) or did not complete any items beyond a practice block ($n = 57$). Because more participants in the comment group ($n = 3$) than the reflection only groups ($n = 1$) did not complete the survey, we included all available data for these participants to reduce potential bias. We removed individual responses in which participants did not provide good faith responses, which we defined as writing five or fewer words ($n_{responses} = 51$, 3.4% of total responses). This yielded a final sample of $N = 448$. Participants were not recruited or excluded on the basis of beliefs about the cause of climate change. Participants were aged 18–92 ($M = 47.5$, $SD = 18.1$). Participants reported the following gender identities: 48.2% men, 47.5% women, 2.2% nonbinary, 0.7% preferred to self-describe their gender, 0.4% preferred not to say, and 0.9% did not report their gender. Participants reported the following racial and ethnic identities: 83.3% White, 7.8% Hispanic or Latina/Latino/Latinx, 5.6% Asian, 4.9% Black or African American, 3.6% More than one race, 1.6% preferred not to say, 0.2%, American Indian or Alaskan Native, and 0.9% did not report their race/ethnicity. This study was approved by the University of Pennsylvania Institutional Review Board, and all participants gave informed consent.

Procedure

This study used a mixed design. Participants were randomly assigned to either the timed reflection ($n = 159$), untimed reflection ($n = 169$), or the comment ($n = 131$) group. As in studies 2–3, participants in all groups viewed articles ($n = 4$) in the self-focused, other-focused, and control conditions, and viewed a subset of 12 articles from the set of 96. After reading and reflecting on the articles according to the intervention condition (self-focused, other-focused, or control), participants rated the articles on the same dimensions as in studies 1–3. In the reflection groups (timed and untimed), participants read and reflected on the articles before rating the messages as they did in the MRI-adapted task version used in study 2. In the timed group, participants had 12 s to read and reflect, whereas in the untimed group, they had unlimited time. Mirroring the design in study 2, participants in the comment group also wrote brief comments as if they were posting on social media in accordance with the content-framing intervention condition.

Statistical analyses

Hypotheses were tested with multilevel modeling using lme4 (Version 1.1–26; (37)) and lmerTest (Version 3.1–3; (38)) packages for significance testing in R (Version 3.6.3; (39)). Models with sharing behavior as the outcome use multilevel logistic regression

with the glmer function from *lme4* (Version 1.1–26; (37)). Continuous variables were z-scored to facilitate interpretation of standardized effects. We strove for a maximal random effects structure to improve generalizability (40). In all models, intercepts and slopes were allowed to vary randomly across participants and articles unless the model did not converge or converged a singular fit, in which case random intercepts only were specified. When estimating relationships jointly across studies, we fit the same models, including data from all studies. In these models, intercepts were also allowed to vary randomly and slopes were allowed to vary randomly where possible; study was not included as a random effect given that there were so few studies. In all models, degrees of freedom (df) were calculated using the Satterthwaite approximation. All *P*-values reported are from two-tailed tests. Detailed information about each model and how each model was fit is provided in the code repository.

Hypotheses H1–6 analyses

H1 was tested by regressing broadcast and narrowcast sharing intentions, and sharing behavior on the fixed effects of (i) self and (ii) social relevance. H2 was tested by regressing (i) self-relevance and (ii) social relevance on the fixed effect of intervention condition. H3 was tested by regressing broadcast and narrowcast sharing intentions, and sharing behavior on the fixed effects of intervention condition. H4 was tested by regressing (i) self-relevance on the fixed effect of self-referential ROI activity and (ii) social relevance on the fixed effect of social cognitive ROI activity. H5 was tested by regressing narrowcast sharing intentions on the fixed effect of (i) self-referential ROI activity and (ii) social cognitive ROI activity. H6 was tested by regressing (i) self-referential and (ii) social cognitive ROI activity on the intervention condition. We also tested potential mediation of intervention-related effects on sharing through self and social relevance using Bayesian multilevel parallel mediation. These analyses are reported in Supplementary material. Additional sensitivity analyses using ROIs from brain regions associated with valuation and auditory processing (a "control" ROI) are reported in Supplementary material.

Study 4 analyses

Condition effects by group

We tested whether the comment group would be more effective than the reflection groups by regressing (i) self-relevance, (ii) social relevance, (iii) broadcast, and (iv) narrowcast sharing intentions on intervention condition, group, and their interaction. These analyses are reported in Supplementary material.

Word count

In the comment group, we tested whether deeper engagement with the manipulation would lead to greater effectiveness by regressing (i) self-relevance, (ii) social relevance, (iii) broadcast, and (iv) narrowcast sharing intentions on word count. We replicate these analyses in studies 1 and 2 and report them in Supplementary material.

Exploratory analyses

Moderation analyses

We explored how the hypothesized relationships in H1–6 might differ as a function of article topic (climate change or health) and cultural context (United States of America or the Netherlands) by including the variable as an interaction term in the H1–6 models.

Climate action

We explored the degree to which the content-framing interventions increased intentions to share petitions about climate action using multilevel modeling and regressing (i) broadcast and (ii) narrowcast sharing intentions on the fixed effects of intervention group. We examined the degree to which the content-framing interventions increased the perceived environmental impact of 12 individual and collective actions using multilevel modeling. We regressed perceived impact on the fixed effects of intervention group. We used linear regression to test group differences in perceived knowledge about climate change and self-efficacy.

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E.B.F. serves on the scientific advisory board for Kumanu, a digital well-being company.

Supplementary Material

Supplementary material is available at *PNAS Nexus* online.

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Preprints

This manuscript was posted on a preprint: osf.io/preprints/psyarxiv/z8946.

Data Availability

The data and analysis code needed to reproduce the analyses in all studies are available online (https://github.com/cnlab/sharing-motivation). The stimuli used in this study are available online (https://osf.io/ak6wf).

Positionality Statement

In acknowledgement that our identities can influence our approach to science (41), the authors wish to provide the reader with information about our backgrounds. With respect to gender, when the manuscript was drafted, nine authors self-identified as women, four as men, and one as nonbinary. With respect to race and ethnicity, nine authors self-identified as White, two as White and Latinx, one as Asian, and one as White and Asian. With respect to nationality, 10 authors self-identified as American, one as Dutch, one as German, and one as American and Canadian. With respect to age, all authors are younger than 50.

Citation Diversity Statement

Recent work in several fields of science has identified a bias in citation practices such that papers from women and other minority scholars are under-cited relative to the number of such papers in the field (42–50). Here, we sought to proactively consider choosing references that reflect the diversity of the field in thought, form of contribution, gender, race, ethnicity, and other factors. First, we obtained the predicted gender of the first and last author of each reference (excluding software package citations) by using databases that store the probability of a first name being carried by a woman (43, 45, 46, 48, 49, 51). By this measure, our citations contain 35% women and 65% men across all authors from nonsoftware references; 42% women and 57% men considering only first and last authors from nonsoftware references; and 100% men across software references. This method is limited in that (i) names, pronouns, and social media profiles used to construct the databases may not, in every case, be indicative of gender identity and (ii) it cannot account for intersex, nonbinary, or transgender people.

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