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Ideological diversity of media consumption predicts COVID-19 vaccination

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This study examines the relationship between respondents' vaccine hesitancy, reported media consumption patterns, ideological leanings, and trust in science. A large-scale survey conducted in the US in 2022 ($N = 1,646$) assessed self-reported COVID-19 vaccination, trust in science, and reported media consumption. Findings show that, regardless of personal ideology, individuals who consumed less conservative media and had a more ideologically diverse media diet were more likely to be fully vaccinated and boosted. Additionally, consuming more conservative media was negatively associated with trust in science, but this relationship was weaker among those with a more ideologically diverse media diet. By incorporating data from an earlier wave of the survey in the summer of 2020, before COVID-19 vaccines were available, we found that a less conservative and more ideologically diverse media diet in 2022 predicted vaccination behavior in 2022, controlling for prior vaccine intentions and media consumption in 2020. A similar survey conducted in the UK in the summer of 2020 paralleled patterns in the US regarding vaccine intentions and media consumption. These results suggest that an ideologically diverse media diet is associated with reduced vaccine hesitancy. Public health initiatives might benefit from encouraging ideologically diverse media consumption.

COVID-19 underscored that public health crises are social-behavioral problems as much as biomedical problems. Rapid vaccine development and delivery provided an opportunity to minimize the pandemic's damage. But vaccine hesitancy hindered vaccine uptake in the United States (US) and elsewhere. Vaccine hesitancy cost hundreds of thousands of lives during the COVID-19 pandemic[1], not to mention vast social and economic costs[2].

Understanding the factors associated with vaccine hesitancy is important not only for addressing the ongoing threat of COVID-19 but also for tackling other diseases like influenza, which continue to face challenges in vaccine uptake. Vaccine hesitancy was identified as a top ten global threat in 2021[3], and remains a significant public health challenge. Research has highlighted socio-demographic factors that predict vaccine hesitancy, including age, education[4], cognitive reflection[5], ethnicity[6], diminished trust in institutions[7], and conservative ideology[8]. This exploratory study builds on existing literature by examining how reported media consumption is associated with vaccine hesitancy and trust in science, independent of previously documented factors. Specifically, we investigate how two aspects of self-reported media consumption predict vaccine hesitancy and trust in science: the consumption of conservative media and the ideological diversity of consumed media. We

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examine whether these indices of media consumption predict vaccination behavior and trust in science over and above personal ideology and other previously documented factors.

Our findings indicate that consuming more conservative media is negatively associated with self-reported COVID-19 vaccination. Conversely, consuming a greater ideological diversity of media positively predicts COVID-19 vaccination. These patterns emerge even when controlling for vaccine intentions and media consumption from two years prior, as well as personal ideology, age, education, and other individual differences. When examining vaccine intentions measured in 2020, we observe similar trends in the United Kingdom (UK).

Vaccine hesitancy

Even when vaccines are developed and readily accessible[9], vaccine hesitancy is a major barrier to vaccine uptake, with broad consequences for public health. Personal vaccine hesitancy is associated with various demographic, social, and psychological factors[5,10–12]. For example, older people and those with higher socioeconomic status have lower vaccine hesitancy[11,13] as do people who are embedded in social networks with higher rates of vaccination[14].

Psychologically, people may exhibit vaccine hesitancy because they think that the risks of vaccination outweigh the benefits[15] and they may anticipate regret about their vaccine decision[16]. Perceived risks and benefits of vaccines and the diseases they prevent are associated with analytical thinking styles[17] such as cognitive reflection, people's tendency to suppress reflexive responses in favor of a more deliberative, analytical approach to problem solving[18].

COVID-19 vaccination was highly polarized along ideological lines in the US[19], and in other countries[20]. Conservative ideology is a robust predictor of vaccine hesitancy[7,8]. Conservatives have been more resistant to COVID-19 vaccinations[4], government guidance, and public health mandates[20] than liberals. Conservatives' heightened vaccine hesitancy may have contributed to politically polarized health outcomes, with greater COVID-19 deaths among Republicans than Democrats[21].

Demographic factors, psychological attributes, and political ideology shape vaccine hesitancy partly by shaping sociocultural information ecosystems[22–24]. These ecosystems are constructed and reinforced by the media people consume. This study explores whether patterns of media consumption are associated with vaccine hesitancy.

Conservative media in the US (e.g., *Fox News*) conveyed greater skepticism about COVID-19 vaccines than liberal (e.g., *MSNBC*) and neutral media (e.g., *CBS*)[25], potentially contributing to vaccine hesitancy among consumers of conservative media. We therefore examined whether consuming more conservative media predicts vaccine hesitancy over and above political ideology. We also examined whether consuming a more ideologically diverse media diet would be associated with reduced vaccine hesitancy, potentially offsetting the association between conservative media consumption and vaccine hesitancy.

Trust in science

Lower levels of trust in science contribute to vaccine hesitancy[26]. During COVID-19, the degree to which people trusted science predicted more favorable attitudes toward social distancing, vaccines[26,27], and skepticism of conspiracy theories[28]. Trust in science may predict lower vaccine hesitancy because it undergirds people's belief in the efficacy and safety of vaccines, reducing skepticism and encouraging adherence to health guidelines. Declining levels of trust in science are associated with increasing vaccine hesitancy[29]. Understanding the factors that predict trust in science is thus crucial to bolster public adherence to science-based public health guidance[30].

Many factors that predict vaccine hesitancy also predict lower trust in science, including age, socioeconomic status, analytical thinking, and political ideology[26,27,31–33]. Of particular interest in this study is ideology, as trust in science among conservatives has declined since the onset of COVID-19 pandemic[34]. From 2020 to 2023, the percentage of Republicans reporting that they had little to no trust "in scientists to act in the best interests of the public" rose from 14 to 38 percent[35]. Although some degree of skepticism toward scientific practice may be warranted, trust in science is a strong predictor of adherence to science-based public health guidance.

Lower trust in science may stem from concerns perpetuated by conservative media regarding the scientific vaccine research and development process[36]. Narratives from conservative media that call into question the integrity of public health officials and skepticism about the vaccine development process can lead to greater vaccine hesitancy[37,38]. Our study thus explored whether self-reported consumption of conservative media was associated with lower trust in science. As with vaccine hesitancy, we also explored whether consuming a more ideologically diverse media would predict trust in science, potentially offsetting the association between conservative media consumption and trust in science.

Conservative media and ideologically diverse media diets

Research on media consumption and vaccine hesitancy has focused on the specific content of vaccine messaging[5]. One study found that framing COVID-19 vaccine messages around personal health risk and public health concerns increased vaccine intentions[39]. We explored whether other characteristics of people's media diet are correlated with vaccine hesitancy and trust in science, specifically, the consumption of more conservative media and more ideologically diverse media, without focusing on the specific content of vaccine messaging.

Conservative media Conservative outlets tend to convey skepticism about vaccines[40] and science[41]. *Fox News* pundit Sean Hannity, for example, claimed that COVID-19 was made up by the "deep state"; *Fox Business* anchor Trish Regan told viewers that the worry over COVID-19 was an attempt to impeach President Donald Trump[42,43]. If such messaging characterizes conservative media more generally, then conservative outlets may perpetuate vaccine hesitancy and reduce trust in science.

Examining the relationship between conservative media consumption, vaccine hesitancy, and trust in science is important because conservative media consumption often intersects with other factors. One key factor is the perceived reliability of media, or the truthfulness and accuracy of information presented, and how sensationalized the information is (e.g., misleading imagery, eye-catching headlines)[44]. Consuming less reliable media may expose viewers to more misinformation. Consider data from Ad Fontes Media[45], a nonpartisan organization that uses analysts from various ideological backgrounds to evaluate articles from multiple media outlets. The correlation between ratings of the conservative tilt of the 35 most-visited news media outlets[46] and ratings of those outlets' reliability is negative ($R = -.35$). Another factor is the threatening language conveyed in media[47]. Media that conveys threat is associated with a range of outcomes, including dehumanization[48], heightened concerns surrounding antibiotic resistance[49], deaths due to pathogen outbreaks, including COVID-19, political shifts in approval of sitting US presidents, and anti-immigrant attitudes[47]. Conservative media consumption may therefore often be confounded with the consumption of reliable media and consumption of threat conveyed in media.

The consumption of conservative media is also confounded with personal ideology. People typically consume media that aligns with their ideological identities[50]. Conservatives are more likely than liberals, not surprisingly, to consume conservative media like *Fox News*. Associations between conservative media consumption and vaccine hesitancy in previous research may therefore reflect the link between conservative ideology and vaccine hesitancy[50]. In our study, we examined whether conservative media consumption predicted vaccine hesitancy and lower trust in science, controlling for personal ideology.

Ideologically diverse media Ideological diversity of media consumption is the most novel characteristic explored in the present study[51]. Scholars have discussed the importance of an ideologically diverse media diet to counter "echo chambers" and combat misinformation[40,52,53]. Consuming ideologically diverse media outlets reduces the likelihood that people are exposed only to misleading information about vaccines and science. A more diverse media diet should be associated with a reduction in the proportion of inaccurate or misleading information consumed. An ideologically diverse media diet should also be associated with an increased likelihood of exposure to accurate content about vaccines and science.

Additionally, being exposed to ideologically diverse media may encourage people to consider a diversity of perspectives, and prompt them to think more critically about evidence. Consuming ideologically diverse media often entails consuming news from greater number of outlets, akin to a strategy used by fact-checkers who read simultaneously from multiple outlets to gain different perspectives on a given topic[54]. Consuming information from multiple outlets can improve media consumers' ability to identify scientific misinformation[55]. In our study, we therefore examined whether consuming ideologically diverse media predicted reduced vaccine hesitancy, increased trust in science, and moderated the relationship between conservative media consumption and key outcomes.

Results

Predicting COVID-19 vaccination behavior in the United States

We conducted surveys in summer 2020, fall 2020, and spring 2022. Our analysis of vaccination behavior uses only the data from spring 2022, because the COVID-19 vaccine was not available during 2020 surveys. The COVID-19 vaccine was approved in the US in December 2020[56], became broadly available by April 2021[57], and was widely mandated by schools and employers[58]. By the time of our 2022 survey, in late March and early April 2022, the boosters had been widely available to the public since November 2021[59].

Respondents reported which COVID-19 level of vaccination they had received in 2022 (coded as 1 = not vaccinated, 21% of respondents; 2 = fully vaccinated, 17% of respondents; 3 = fully vaccinated and boosted, 62% of respondents). We assessed self-reported ideology (-3 = *Very liberal*, $+3$ = *Very conservative*), age, formal education in years ($M = 14.63$, $SD = 2.62$, range: 1–17), and ethnicity (coded as white = 0.5, non-white = -0.5). Cognitive reflection was measured as the proportion of correct answers ($M = 0.40$, $SD = 0.31$) on six questions designed to elicit incorrect intuitive responses over correct deliberative ones[18]. For information on exclusions see Methods; for detailed demographic information see Supplemental Table 1.

We measured self-reported media consumption by asking respondents how much (0 = *Not at all*, 6 = *A great deal*) they received their COVID-19 news from 20 outlets in spring 2022. We measured the conservative tilt of each media outlet as the average of standardized ratings from AllSides[60] and Ad Fontes Media[45] (Supplemental Table 2), which were highly correlated ($R = .97$)[61]. Higher scores indicate more conservative outlets. As an index of the degree to which each respondent consumed conservative media, we first calculated the product of that respondent's self-reported consumption of each outlet and the standardized rating of that outlet's conservative tilt. We then calculated the average of these 20 products for each respondent.

As an index of the degree to which each respondent consumed an ideological diversity of media, we calculated the standard deviation of the 20 products of media consumption and media conservative tilt rating for each respondent. A typical person who consumed a relatively more diverse media (+1 SD) consumed around 10 outlets ranging from *Fox News* and the *Wall Street Journal* on the conservative side to *CNN* and the *MSNBC* on the liberal side, whereas a person who consumed less diverse news media (–1 SD) typically consumed around 4 outlets with common choices being *Fox News*, *Wall Street Journal*, and *Breitbart* for conservative leaning outlets and *CNN*, *NBC*, and *ABC*, and *Yahoo! News* for liberal leaning outlets. We standardized both ideological diversity of media consumption and conservative tilt of media consumption indices in each wave. Table 1 presents the zero-order correlations between measures.

	1	2	3	4	5	6	7	8	9	10
1. Vaccination Intentions (2020)	1.00									
2. Trust in Science	0.40***	1.00								
3. Age	0.17***	0.06+	1.00							
4. Education	0.07*	0.13***	0.00 ns	1.00						
5. Ideology	-0.18***	-0.45***	0.13***	-0.06+	1.00					
6. Cognitive Reflection	0.10**	0.14***	0.03 ns	0.21***	0.01 ns	1.00				
7. Conservative Media Consumption 2020	-0.21***	-0.32***	0.13***	-0.02 ns	0.49***	0.14***	1.00			
8. Conservative Media Consumption 2022	-0.20***	-0.51***	-0.03 ns	-0.07*	0.53***	0.03 ns	0.66***	1.00		
9. Diversity of Media Consumption 2020	0.23***	0.09**	-0.03 ns	-0.02 ns	-0.08*	-0.17***	-0.48***	-0.22***	1.00	
10. Diversity of Media Consumption 2022	0.19***	-0.03 ns	-0.10**	-0.04 ns	-0.10**	-0.24***	-0.42***	-0.17***	0.61***	1.00

Table 1. Pairwise correlations between standardized measures. Measures for 2020 for conservative media consumption and diversity of media consumption taking the average of summer 2020 and fall 2020 measures. $p \geq .10$ ns, $p < .10^+$, $p < .05$ *, $p < .01$ **, $p < .001$ ***.

People who reported consuming more conservative media were less likely to be vaccinated and boosted (as opposed to unvaccinated or only fully vaccinated). People who reported consuming a more ideologically diverse media diet were more likely to be vaccinated and boosted.

Using proportional ordinal logistic regression, we estimated self-reported vaccination behavior from 20 standardized predictors (Table 2A). Odds ratios less than one indicate a negative relationship between predictors and outcomes; odds ratios greater than one indicate a positive relationship between predictors and outcomes. Respondents' consumption of conservative media negatively predicted self-reported vaccine status (OR = 0.52, SE = 0.07, T = −5.16, P < .001; Table 2A, Fig. 1, Panel A). This effect was independent of respondents' personal ideology (OR = 0.77, SE = 0.07, T = −3.03, P = .003), cognitive reflection (OR = 1.22, SE = 0.11, T = 2.28, P = .023), age (OR = 1.74, SE = 0.15, T = 6.32, P < .001), education (OR = 1.35, SE = 0.12, T = 3.43, P = .001), and white ethnicity (OR = 0.91, SE = 0.16, T = −0.50, P = .617)[8].

Respondents' consumption of a greater ideological diversity of media was associated with a higher likelihood of being vaccinated and boosted (OR = 1.53, SE = 0.16, T = 4.19, P < .001; Table 2A, Fig. 1, Panel B). Additionally, there was an interaction between consuming conservative media and consuming a greater diversity of media (OR = 1.47, SE = 0.20, T = 2.91, P = .004). Consuming more conservative media was a stronger negative predictor of being vaccinated and boosted when estimated at relatively low diversity of media consumption (−1 SD, OR = 0.35, SE = 0.08, T = −4.65, P < .001) than when estimated at relatively high diversity of media consumption (+1 SD, OR = 0.76, SE = 0.10, T = −2.04, P = .042).

In sum, consuming more conservative media predicts lower COVID-19 vaccination, while consuming a greater ideological diversity of media predicts higher vaccination. The negative association between conservative media consumption and vaccination was smaller for those who reported a more ideologically diverse media diet. These effects were independent of demographics, cognitive reflection, and personal ideology.

Predicting trust in science in the United States

We measured trust in science[30] as respondents' average of agreement (1 = *Strongly disagree*, 5 = *Strongly agree*) with 15 statements, such as "We can trust science to find the answers that explain the natural world." We estimated trust in science in a multiple linear regression simultaneously from 19 (standardized) predictors (Table 2B), the same as described above.

Conservative media consumption and ideological diversity of media consumption interactively predicted trust in science. Respondents' consumption of conservative media negatively predicted trust in science (β = −0.53, SE = 0.04, T = −11.94, P < .001). Counter to prediction, greater diversity of media consumption also negatively predicted trust in science (β = −0.07, SE = 0.03, T = −2.15, P = .032).

However, these two main effects were qualified by an interaction between conservative and diversity of media consumption (β = 0.21, SE = 0.04, T = 4.76, P < .001, Fig. 2). Consuming conservative media was a stronger negative predictor of trust in science when estimated at relatively low diversity of media consumption (−1 SD, β = −0.74, SE = 0.08, T = −9.63, P < .001) than when estimated at relatively high diversity of media consumption (+1 SD, β = −0.32, SE = 0.04, T = −7.27, P < .001). These results indicate that consuming more ideologically diverse media reduces the negative correlation between conservative media consumption and trust in science. This interaction effect is over and above that of ideology (β = −0.23, SE = 0.03, T = −7.49, P < .001), cognitive reflection (β = 0.10, SE = 0.03, T = 3.40, P = .001), education (β = 0.06, SE = 0.03, T = 1.89, P = .059), age (β = 0.07, SE = 0.03, T = 2.33, P = .020), identification as white (β = 0.19, SE = 0.06, T = 3.05, P = .002), and their interactions (Table 2B).

Trust in science significantly predicted vaccination behavior (Supplemental Table 3). In the proportional ordinal logistic regression model, trust in science had a strong positive effect (OR = 1.79, SE = 0.20, T = 5.09, P < .001), along with conservative media consumption (OR = 0.72, SE = 0.10, T = −2.42, P = .016) and diversity of media consumption (OR = 1.43, SE = 0.16, T = 3.32, P = .001). Notably, a negative interaction between trust in science and media diversity (OR = 0.77, SE = 0.08, T = −2.45, P = .015) indicated that media diversity was a stronger predictor of vaccination at low levels of trust in science (OR = 1.85, SE = 0.25, T = 4.67, P < .001) than
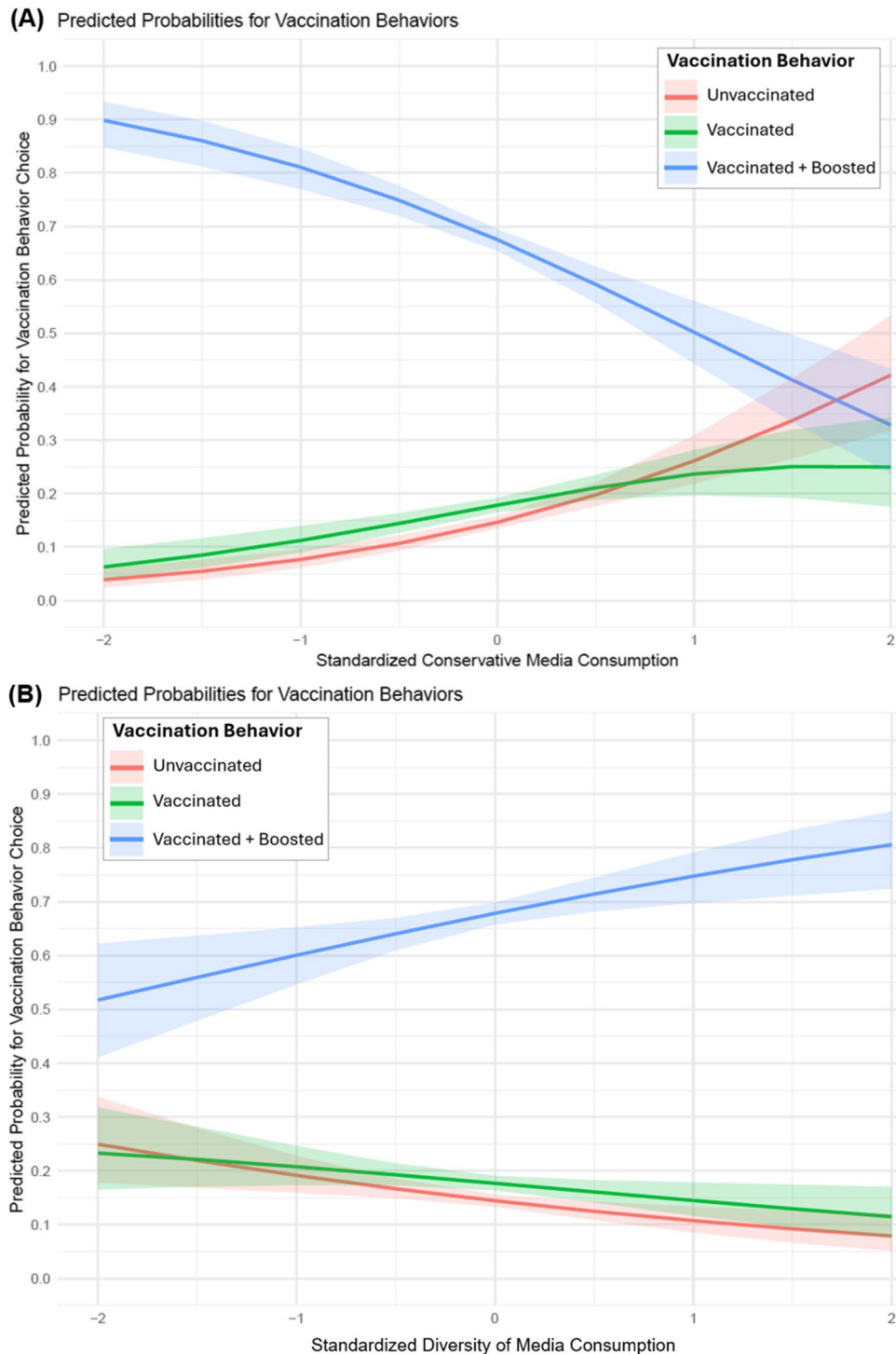
(A) Outcome: Vaccination Behavior (N = 909)					
Predictors (all standardized)	OR	SE	CI	T	P
1|2	0.20	0.02	[0.15, 0.25]	-13.76	**< 0.001**
2|3	0.55	0.06	[0.45, 0.68]	-5.63	**< 0.001**
Conservative Media Consumption (CMC)	0.52	0.07	[0.40, 0.66]	-5.16	**< 0.001**
Diversity of Media Consumption (DMC)	1.53	0.16	[1.26, 1.88]	4.19	**< 0.001**
Cognitive Reflection (CRT)	1.22	0.11	[1.03, 1.45]	2.28	**0.023**
Ideology	0.77	0.07	[0.65, 0.91]	-3.03	**0.003**
Ethnicity	0.91	0.16	[0.64, 1.29]	-0.50	0.617
Age	1.74	0.15	[1.47, 2.07]	6.32	**< 0.001**
Education	1.35	0.12	[1.14, 1.61]	3.43	**0.001**
CMC x DMC	1.47	0.20	[1.13, 1.92]	2.91	**0.004**
CMC x CRT	1.01	0.09	[0.85, 1.19]	0.07	0.944
CMC x Ideology	0.93	0.08	[0.79, 1.10]	-0.83	0.405
CMC x Ethnicity	0.82	0.17	[0.55, 1.22]	-0.99	0.325
CMC x Age	0.92	0.09	[0.76, 1.12]	-0.79	0.427
CMC x Education	0.95	0.10	[0.78, 1.16]	-0.54	0.586
DMC x CRT	1.05	0.10	[0.88, 1.27]	0.57	0.571
DMC x Ideology	1.10	0.09	[0.94, 1.29]	1.15	0.249
DMC x Ethnicity	0.82	0.14	[0.58, 1.14]	-1.18	0.237
DMC x Age	1.03	0.10	[0.86, 1.25]	0.35	0.727
DMC x Education	0.93	0.07	[0.80, 1.07]	-0.94	0.346
(B) Standardized Trust in Science (N = 908)					
Predictors (all standardized)	β	SE	CI	T	P	$\eta2$
Intercept	0.02	0.04	[-0.05, 0.09]	0.64	0.521	--
Conservative Media Consumption (CMC)	-0.53	0.04	[-0.62, -0.44]	-11.94	**< 0.001**	0.156
Diversity of Media Consumption (DMC)	-0.07	0.03	[-0.14, -0.01]	-2.15	**0.032**	0.005
Cognitive Reflection (CRT)	0.10	0.03	[0.04, 0.16]	3.40	**0.001**	0.012
Ideology	-0.23	0.03	[-0.28, -0.17]	-7.49	**< 0.001**	0.060
Ethnicity	0.19	0.06	[0.07, 0.32]	3.05	**0.002**	0.011
Age	0.07	0.03	[0.01, 0.13]	2.33	**0.020**	0.005
Education	0.06	0.03	[0.00, 0.12]	1.89	0.059	0.003
CMC x DMC	0.21	0.04	[0.12, 0.30]	4.76	**< 0.001**	0.025
CMC x CRT	-0.01	0.03	[-0.07, 0.04]	-0.46	0.646	0.000
CMC x Ideology	-0.01	0.03	[-0.06, 0.04]	-0.43	0.668	0.000
CMC x Ethnicity	-0.08	0.06	[-0.20, 0.05]	-1.23	0.218	0.002
CMC x Age	0.06	0.03	[0.00, 0.12]	1.93	0.054	0.004
CMC x Education	0.02	0.04	[-0.05, 0.09]	0.66	0.508	0.000
DMC x CRT	0.03	0.03	[-0.04, 0.09]	0.85	0.396	0.001
DMC x Ideology	0.05	0.03	[0.00, 0.11]	1.81	0.070	0.004
DMC x Ethnicity	-0.08	0.06	[-0.20, 0.04]	-1.33	0.182	0.002
DMC x Age	0.10	0.03	[0.04, 0.16]	3.17	**0.002**	0.011
DMC x Education	-0.04	0.02	[-0.09, 0.00]	-1.77	0.077	0.004

Table 2. (A) Proportional ordinal logistic regression predicting self-reported COVID-19 vaccination in spring 2022, and (B) multiple linear regressions predicting self-reported trust in science in 2022. All continuous predictors and outcomes are standardized; ethnicity is contrast coded (white = 0.5, non-white = −0.5). 1|2 indicates the odds of being unvaccinated compared to vaccinated or vaccinated and boosted. 2|3 indicates the odds of being vaccinated and boosted compared to unvaccinated or only vaccinated. Note: bolded p-values indicate significant findings. Bolded *p*-values indicate significant findings

at high levels (OR = 1.11, SE = 0.19, T = 0.61, *P* = .542). These results suggest that a diverse media diet may buffer against the vaccine hesitancy associated with relatively low trust in science.

Predicting COVID-19 vaccination intentions in the United States and United Kingdom

The preceding results show that in the US, the likelihood of being vaccinated and boosted is negatively predicted by consuming more conservative media and positively predicted by having a more ideologically diverse media

Figure 1. Conservative media consumption (Panel A) and ideological diversity of media consumption (Panel B) predict the probability for self-reported vaccination behavior at each level ($N = 909$) in the US in spring 2022, with controls listed in Table 2A. Predictors are all standardized. Each line predicts the odds of reporting the indicated level of vaccination, rather than the other two options.

diet. Given the high levels of vaccine hesitancy in the highly polarized US, we explored whether similar patterns would also be observed in the UK.

We measured vaccine intentions in both countries by asking respondents if they would get a COVID-19 vaccination ($-3 = $ *Definitely would not get it*, $0 = $ *Undecided*, $+3 = $ *Definitely would get it*). Respondents in the US self-reported how much they received their COVID-19 news ($0 = $ *Not at all*, $4 = $ *A great deal*) from 15 popular US media outlets (Supplemental Table 2), and UK respondents from eight popular UK media outlets (Supplemental Table 4). Conservative media consumption and diversity of media consumption were calculated using the same
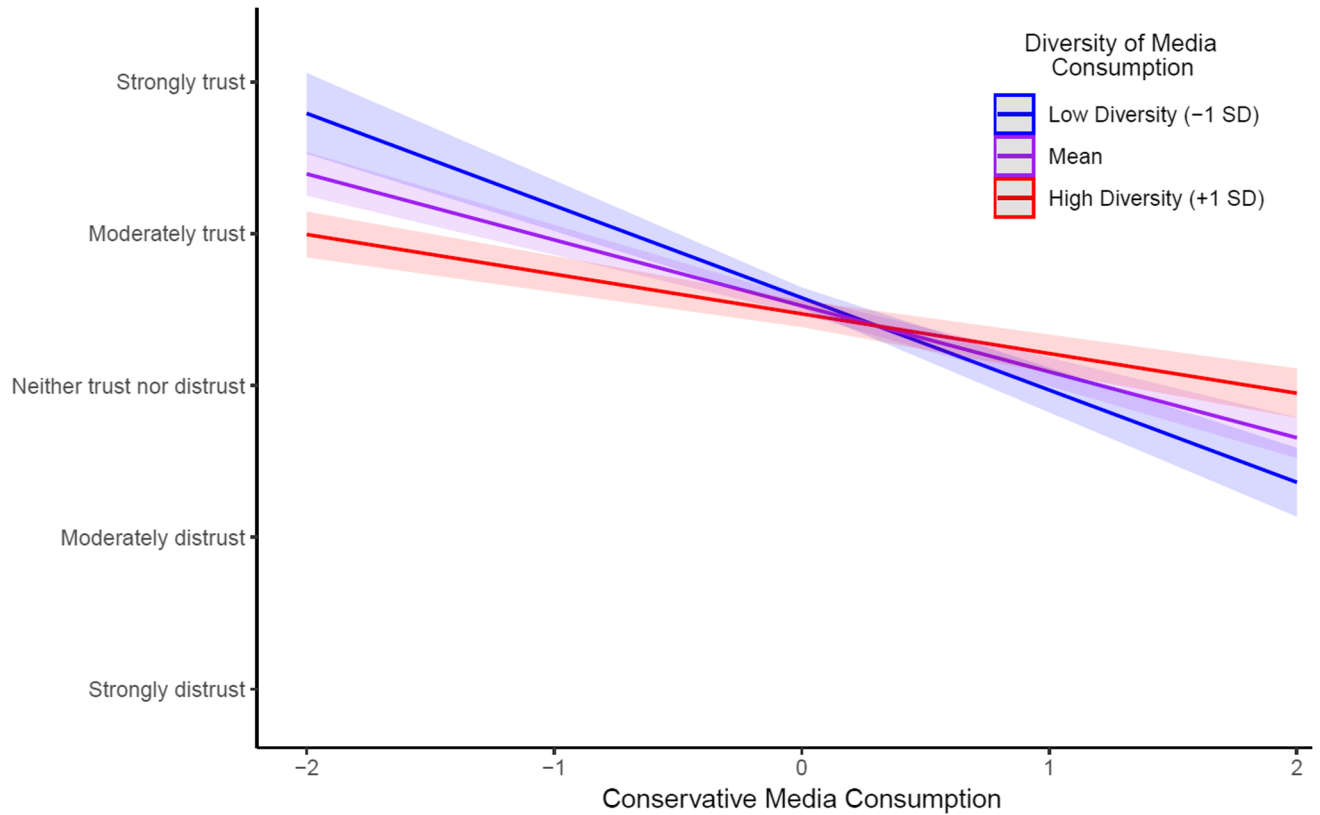
Figure 2. Conservative media consumption and ideological diversity of media consumption interactively predict trust in science (*N* = 908) in the US in spring 2022, with controls listed in Table 2B. Consumption of conservative media is a weaker negative predictor of trust in science when estimated at −1 SD in ideological diversity of media consumption. All outcomes and predictors are standardized.

approach described above, using ratings from all eight media outlets from the UK and 15 media outlets from the US. All predictors and outcomes were standardized within each country.

We estimated a multiple linear regression predicting vaccine intentions in both the US and UK (US = –0.5, UK = 0.5), including predictors and their interactions as in the previously reported models predicting vaccine behaviors. The patterns of results for vaccine intentions were similar to those for vaccine behaviors, with no significant differences between the US and UK (Table 3). Consuming more conservative media predicted lower vaccine intentions in both the US ($\beta = -0.21$, SE = 0.03, T = −7.33, *P* < .001) and the UK ($\beta = -0.11$, SE = 0.04, T = − 2.45, *P* = .014), and this effect did not significantly differ between the two countries ($\beta = 0.10$, SE = 0.05, T = 1.89, *P* = .059). Additionally, consuming a more diverse media diet predicted higher vaccine intentions in both the US ($\beta = 0.04$, SE = 0.02, T = 1.96, *P* = .050) and the UK ($\beta = 0.07$, SE = 0.03, T = 2.49, *P* = .013), with no significant difference between the two countries ($\beta = 0.03$, SE = 0.04, T = 0.78, *P* = .437).

These results suggest that patterns of conservative media consumption and ideological diversity of media consumption are similarly predictive of vaccine intentions in the US and the UK. Analyses indicate several other differences between countries, such as the correlations between age and education with vaccination intentions (Table 3). However, these differences may be due to other factors unrelated to media consumption, such as public health policies regarding vaccine access, which are beyond the focus of the present investigation.

Panel survey analyses

An important question is whether people who consume less conservative media and a greater ideological diversity of media are more likely to be vaccinated and boosted for reasons related to individual-level factors that might be correlated with media consumption. We partially addressed this question by incorporating data from the two 2020 waves of the US panel survey. This included vaccine intentions along with conservative media consumption and ideological media diversity, calculated as reported above (Table 4). Specifically, respondents reported their intentions to receive the (not-yet-approved) vaccines (–3 = *Definitely would not get it*, +3 = *Definitely would get it*). Media consumption was measured similarly, but with 15 outlets in 2020.

By including 2020 media consumption and vaccine intentions in the model predicting 2022 vaccination behavior, we controlled for individual-level factors related to vaccine intentions, conservative tilt, and diversity of media consumption. Conservative media consumption in 2022 was strongly correlated with its 2020 levels (*R* = .66, *P* < .001), as was media diversity in 2020 and 2022 (*R* = .61, *P* < .001). These strong correlations suggest that media consumption patterns are relatively stable over time. Including the 2020 measures of media

Predictors (all standardized)	Outcome: Standardized Vaccination Intentions											
	Model 1 Country: US = −0.5, UK = 0.5				Model 2 Country: US = 0, UK = 1				Model 3 Country: UK = 0, US = 1			
	β	SE	t	p	β	SE	t	p	β	SE	t	p
Intercept	0.02	0.02	1.06	0.291	0.03	0.02	1.44	0.151	0.01	0.03	0.24	0.807
Conservative Media Consumption (CMC)	-0.16	0.03	-6.00	**<0.001**	-0.21	0.03	-7.33	**<0.001**	-0.11	0.04	-2.45	**0.014**
Diversity of Media Consumption (DMC)	0.06	0.02	3.14	**0.002**	0.04	0.02	1.96	**0.050**	0.07	0.03	2.49	**0.013**
Country	-0.02	0.03	-0.73	0.465	-0.02	0.03	-0.73	0.465	0.02	0.03	0.73	0.465
Ideology	-0.13	0.02	-7.84	**<0.001**	-0.15	0.02	-7.50	**<0.001**	-0.12	0.03	-4.25	**<0.001**
Age	0.10	0.02	6.16	**<0.001**	0.17	0.02	9.72	**<0.001**	0.02	0.03	0.75	0.454
Education	0.04	0.02	2.33	**0.020**	0.09	0.02	4.93	**<0.001**	-0.02	0.03	-0.69	0.489
CMC x DMC	0.02	0.02	0.76	0.445	0.06	0.02	3.10	**0.002**	-0.03	0.04	-0.67	0.504
CMC x Country	0.10	0.05	1.89	0.059	0.10	0.05	1.89	0.059	-0.10	0.05	-1.89	0.059
DMC x Country	0.03	0.04	0.78	0.437	0.03	0.04	0.78	0.437	-0.03	0.04	-0.78	0.437
CMC x Ideology	0.01	0.01	0.69	0.489	0.01	0.01	0.69	0.489	0.01	0.01	0.69	0.489
CMC x Age	0.05	0.02	3.40	**0.001**	0.05	0.02	3.40	**0.001**	0.05	0.02	3.40	**0.001**
CMC x Education	0.01	0.01	0.87	0.386	0.01	0.01	0.87	0.386	0.01	0.01	0.87	0.386
DMC x Ideology	0.08	0.02	4.96	**<0.001**	0.08	0.02	4.96	**<0.001**	0.08	0.02	4.96	**<0.001**
DMC x Age	0.00	0.02	-0.20	0.839	0.00	0.02	-0.20	0.839	0.00	0.02	-0.20	0.839
DMC x Education	-0.03	0.01	-2.21	**0.027**	-0.03	0.01	-2.21	**0.027**	-0.03	0.01	-2.21	**0.027**
Country x Ideology	0.03	0.03	1.01	0.311	0.03	0.03	1.01	0.311	-0.03	0.03	-1.01	0.311
Country x Age	-0.16	0.03	-4.98	**<0.001**	-0.16	0.03	-4.98	**<0.001**	0.16	0.03	4.98	**<0.001**
Country x Education	-0.11	0.03	-3.44	**0.001**	-0.11	0.03	-3.44	**0.001**	0.11	0.03	3.44	**0.001**
CMC x DMC x Country	-0.08	0.04	-1.98	**0.048**	-0.08	0.04	-1.98	**0.048**	0.08	0.04	1.98	**0.048**

Table 3. Multiple linear regression examining the relationship between diversity and conservative media consumption in summer 2020 predicting vaccination intentions in the US and UK ($N = 4,460$). All continuous predictors are standardized within country. Bolded p-values indicate significant findings

nature portfolio

Outcome: Vaccination Behavior					
Predictors (all standardized)	*OR*	*SE*	*CI*	*t*	*p*
1|2	0.11	0.02	[0.08, 0.15]	-14.28	**<0.001**
2|3	0.44	0.06	[0.34, 0.56]	-6.38	**<0.001**
Conservative Media Consumption 2022 (CMC 2022)	0.56	0.10	[0.39, 0.78]	-3.34	**0.001**
Diversity of Media Consumption 2022 (DMC 2022)	1.52	0.21	[1.16, 2.00]	3.01	**0.003**
Conservative Media Consumption 2020 (CMC 2020)	0.89	0.18	[0.60, 1.32]	-0.59	0.552
Diversity of Media Consumption 2020 (DMC 2020)	0.78	0.11	[0.59, 1.02]	-1.78	0.076
Cognitive Reflection (CRT)	1.07	0.10	[0.89, 1.30]	0.74	0.460
Ideology	0.83	0.08	[0.68, 1.00]	-1.97	**0.049**
Ethnicity	0.79	0.16	[0.54, 1.16]	-1.19	0.234
Age	1.55	0.15	[1.28, 1.87]	4.50	**<0.001**
Education	1.35	0.13	[1.12, 1.62]	3.14	**0.002**
Vaccination Intention 2020	3.02	0.27	[2.53, 3.62]	12.13	**<0.001**
CMC 2022 x DMC22	1.29	0.20	[0.94, 1.75]	1.60	0.111
CMC 2020 x DMC20	1.39	0.15	[1.13, 1.71]	3.14	**0.002**
CMC 2022 x CRT	0.85	0.11	[0.65, 1.10]	-1.27	0.206
CMC 2022 x Ideology	0.97	0.12	[0.75, 1.25]	-0.27	0.785
CMC 2022 x Ethnicity	1.60	0.48	[0.89, 2.88]	1.58	0.115
CMC 2022 x Age	0.67	0.10	[0.50, 0.89]	-2.76	**0.006**
CMC 2022 x Education	0.99	0.15	[0.75, 1.33]	-0.05	0.957
DMC 2022 x CRT	1.06	0.13	[0.83, 1.36]	0.46	0.647
DMC 2022 x Ideology	0.83	0.10	[0.64, 1.06]	-1.51	0.130
DMC 2022 x Ethnicity	0.84	0.20	[0.52, 1.34]	-0.74	0.462
DMC 2022 x Age	1.04	0.13	[0.81, 1.35]	0.34	0.736
DMC 2022 x Education	0.88	0.11	[0.69, 1.11]	-1.03	0.305
CMC 2020 x CRT	1.35	0.21	[1.00, 1.82]	1.97	**0.049**
CMC 2020 x Ideology	1.02	0.15	[0.77, 1.35]	0.12	0.902
CMC 2020 x Ethnicity	0.44	0.15	[0.22, 0.86]	-2.39	**0.017**
CMC 2020 x Age	1.20	0.18	[0.89, 1.63]	1.22	0.225
CMC 2020 x Education	0.90	0.14	[0.66, 1.23]	-0.64	0.524
DMC 2020 x CRT	1.12	0.13	[0.90, 1.41]	1.02	0.310
DMC 2020 x Ideology	1.35	0.16	[1.08, 1.71]	2.57	**0.010**
DMC 2020 x Ethnicity	0.54	0.15	[0.31, 0.91]	-2.30	**0.022**
DMC 2020 x Age	1.09	0.13	[0.87, 1.39]	0.75	0.454
DMC 2020 x Education	0.99	0.12	[0.79, 1.25]	-0.04	0.966

Table 4. Longitudinal multiple linear regression examining the relationship between conservative and diversity of media consumption in spring 2022 predicting vaccination behaviors ($N = 909$), controlling for 2020 diversity of media consumption, conservative media consumption, and vaccination intentions. All continuous predictors are standardized. Media consumption calculations include 20 total media outlets in 2022 and 15 in 2020. 1\|2 indicates the odds of being unvaccinated compared to vaccinated or vaccinated and boosted. 2\|3 indicates the odds of being vaccinated and boosted compared to unvaccinated or only vaccinated. Bolded *p*-values indicate significant findings

consumption help account for individual differences and suggest that any effect of 2022 media consumption on vaccination behavior reflects changes in conservative and diverse media consumption relative to 2020.

Higher conservative media consumption in 2022 predicted lower self-reported vaccination (OR = 0.56, SE = 0.10, T = −3.34, P = .001). Higher media diversity predicted higher vaccination (OR = 1.52, SE = 0.21, T = 3.01, P = .003). Vaccination behavior was also predicted by vaccine intentions (OR = 3.02, SE = 0.27, T = 12.13, P < .001) and ideology (OR = 0.83, SE = 0.08, T = −1.97, P = .049), but not by 2020 conservative media consumption (OR = 0.89, SE = 0.18, T = −0.59, P = .552) or by 2020 diversity of media consumption (OR = 0.78, SE = 0.11, T = −1.78, P = .076). These results indicate that changes in conservative and diversity of media consumption from 2020 to 2022 predicted COVID-19 vaccination.

Robustness checks: threat content and reliability

As noted earlier, consumption of conservative media may be correlated with consuming more reliable media or media with content regarding risks such as pandemics and natural disasters. To examine these possibilities, we obtained 19 media outlet reliability ratings from Ad Fontes Media[45], which captures reliability scores for news outlets that rates from "contains inaccurate, fabricated information" to "original, high effort, fact reporting". We

standardized each measure, computed the product of each respondent's media consumption rating and that media outlet's score, and took the average of those products.

To measure threat content, we obtained transcripts from written articles, radio shows, podcasts, and television broadcasts from each of the 12 outlets that mentioned COVID-19 for the four weeks prior to each 2020 survey. We submitted that content to the Linguistic Inquiry and Word Count (LIWC) text-analysis program[62] using the 2022 Threat Dictionary[47]. We took an average for each of the 12 outlets' threat content scores in summer 2020 and fall 2020 to create threat content scores using respondents' reported media consumption in spring 2022. We then computed a summary measure for threat content, using the same approach as when computing our other summary measures of media consumption[47].

Consumption of reliable media was negatively correlated with consumption of conservative media ($R = -.85$, $P < .001$) and modestly correlated with consuming more ideologically diverse media ($R = .09$, $P = .007$). The threat content of media consumed was not correlated with either measure.

We added the reliability and threat content measures one at a time to the model predicting vaccine behavior (Table 5). Consuming more reliable media significantly predicted vaccination (OR = 1.50, SE = 0.29, T = 2.10, $P = .036$) and the effect of conservative media consumption was no longer significant (OR = 0.73, SE = 0.15, T = −1.55, $P = .122$). This suggests that the effect of consuming more conservative media in predicting vaccine behavior is at least partly attributable to the effect of consuming less reliable media. Diversity of consumption remained a significant positive predictor of vaccination (OR = 1.63, SE = 0.18, T = 4.48, $P < .001$), as was the interaction between conservative media consumption and diversity of media consumption (OR = 1.93, SE = 0.48, T = 2.66, $P = .008$). Therefore, the effects of consuming more ideologically diverse media are not fully attributable to consuming more reliable media.

When threat content was included in the model, conservative media (OR = 0.50, SE = 0.07, T = -5.22, $P < .001$), diversity of media (OR = 1.55, SE = 0.18, T = 3.90, $P < .001$), and their interaction (OR = 1.45, SE = 0.20, T = 2.67,

Outcome: Vaccination Behavior								
	Threat Model				Reliability Model			
Predictors (all standardized)	OR	SE	t	p	OR	SE	t	p
1|2	0.20	0.02	-13.41	**<0.001**	0.19	0.02	-13.21	**<0.001**
2|3	0.57	0.06	-5.24	**<0.001**	0.54	0.06	-5.47	**<0.001**
Conservative Media Consumption (CMC)	0.50	0.07	-5.22	**<0.001**	0.73	0.15	-1.55	0.122
Diversity of Media Consumption (DMC)	1.55	0.18	3.90	**<0.001**	1.63	0.18	4.48	**<0.001**
Communication Style of Media Consumption (CSMC)	1.06	0.11	0.57	0.571	1.50	0.29	2.10	**0.036**
Cognitive Reflection (CRT)	1.23	0.11	2.39	**0.017**	1.23	0.11	2.34	**0.019**
Ideology	0.77	0.07	-3.07	**0.002**	0.76	0.07	-3.10	**0.002**
Ethnicity	0.94	0.17	-0.36	0.722	0.91	0.16	-0.54	0.590
Age	1.75	0.16	6.27	**<0.001**	1.75	0.16	6.27	**<0.001**
Education	1.35	0.12	3.38	**0.001**	1.35	0.12	3.44	**0.001**
CMC × DMC	1.45	0.20	2.67	**0.008**	1.93	0.48	2.66	**0.008**
CMC × CSMC	0.89	0.09	-1.23	0.220	1.03	0.08	0.37	0.711
DMC × CSMC	0.88	0.10	-1.16	0.246	1.38	0.32	1.39	0.164
CMC × CRT	1.02	0.09	0.25	0.804	1.07	0.19	0.37	0.714
CMC × Ideology	0.92	0.08	-0.99	0.324	1.06	0.17	0.34	0.736
CMC × Ethnicity	0.82	0.17	-0.97	0.331	0.80	0.29	-0.61	0.540
CMC × Age	0.90	0.09	-1.06	0.291	1.03	0.19	0.18	0.859
CMC × Education	0.92	0.10	-0.80	0.423	1.05	0.19	0.27	0.789
DMC × CRT	1.07	0.10	0.71	0.478	1.05	0.10	0.52	0.604
DMC × Ideology	1.08	0.09	0.91	0.365	1.10	0.09	1.12	0.265
DMC × Ethnicity	0.81	0.14	-1.19	0.233	0.80	0.14	-1.24	0.215
DMC × Age	0.98	0.09	-0.24	0.807	1.06	0.10	0.60	0.546
DMC × Education	0.92	0.07	-1.05	0.294	0.95	0.07	-0.67	0.506
CSMC × CRT	1.07	0.09	0.78	0.433	1.09	0.19	0.47	0.640
CSMC × Ideology	1.02	0.09	0.21	0.834	1.12	0.19	0.65	0.518
CSMC × Ethnicity	0.97	0.18	-0.16	0.872	0.90	0.34	-0.29	0.771
CSMC × Age	0.76	0.07	-2.93	**0.003**	1.12	0.21	0.63	0.529
CSMC × Education	0.99	0.09	-0.15	0.884	1.12	0.20	0.65	0.518

Table 5. Proportional ordinal logistic regression models predicting vaccination behavior including threat content (N = 909) and reliability (N = 909) measures independently in each model. Communication style of Media Consumption (CSMC) represents a placeholder for the predictor in each the model's title. Bolded *p*-values indicate significant findings

$P=.008$) remained significant predictors of vaccination. Threat content did not predict vaccination (OR = 1.06, SE = 0.11, T = 0.57, $P=.571$; for additional analyses using linguistic structures see Supplemental Table 5).

Discussion

Vaccine hesitancy impeded the COVID-19 response and continues to challenge public health efforts[7,63]. This research shows that media consumption patterns are linked to vaccine hesitancy and trust in science. Consuming more conservative media was associated with lower likelihood of being vaccinated and boosted, independent of personal ideology, age, education, and cognitive reflection. Conversely, greater ideological diversity in media consumption predicted higher likelihood of being vaccinated and boosted. Moreover, the negative association between conservative media consumption and vaccination was weaker among those with more diverse media diets.

Further research is needed to understand the key attributes of an ideologically diverse media diet. Consuming a diversity of media outlets may resemble the behavior of fact-checkers, who read multiple outlets and cross-reference claims[54]. Diverse media consumption may encourage perspective-taking and openness to public health communication, reducing the likelihood that consumers are exposed only to misleading information about vaccines and science.

Previous research shows that personal ideology influences the conservative tilt of media consumption and that both factors, examined separately, predict vaccine hesitancy and trust in science[40]. Our results suggest that personal ideology and conservative media consumption independently predict trust in science, vaccine intentions, and vaccine hesitancy.

Furthermore, analysis of the panel data across 2020 and 2022 found that individuals who consumed less conservative and more diverse media in 2022 were more likely to be vaccinated and boosted, even after controlling for prior vaccine intentions and media consumption in 2020. These results suggest that changes in media consumption predict vaccination behavior, over and above stable individual differences in media consumption and associated factors.

The study differentiated the predictive effects of conservative media from reliable media consumption. Conservative tilt and reliability ratings of media outlets were negatively correlated, and reliability was modestly correlated with more diversity of media consumption. While reliable media consumption and ideological diversity predicted vaccination, conservative media was no longer significant. Our results suggest that the negative effect of conservative media consumption on vaccination may stem, as least in part, from consumption of less reliable media. Future research should further separate these measures by incorporating a larger set of outlets with conservative tilt ranging orthogonally with reliability ratings.

If future research supports the causal relations implied by the present findings, the pathways implicated here suggest potential interventions to reduce vaccine hesitancy. Promoting a diverse media diet, much like encouraging a balanced diet for better health, could enhance vaccine acceptance.

Methods

All methods were carried out according to relevant guidelines and regulations of the Institutional Review Board (IRB) at the University of Colorado and the Declaration of Helsinki. The University of Colorado Boulder IRB approved and categorized the study as Exempt (Protocol 20–0197). Respondents provided informed consent before completing the study.

Respondents

We recruited three waves in a longitudinal survey in the US using ROI Rocket from August 2–20, 2020 ($N=3,326$), October 30–November 4, 2020 ($N=2,749$), and March 15–April 7, 2022 ($N=1,646$). We recruited UK respondents using Prolific[64] from August 2–20, 2020 ($N=1,520$). We used sampling quotas for age and gender to select respondents for both countries. Portions of these data, not vaccine behaviors and intentions or media consumption in spring 2022, were reported elsewhere[65–67]. For detailed demographic information see Supplemental Table 1.

The spring 2022 survey included 1,646 respondents, but analyses for vaccination behaviors ($N=909$) used a smaller sample. Some respondents (98) did not consent, 81 did not have identification numbers, 215 possessed duplicate identification numbers, two were under 18 years old, 233 did not respond to the vaccination behavior measure, and 108 did not respond to one or more of the predictor measures.

Measures

Vaccine intentions and behaviors We measured vaccine behaviors in 2022, when Moderna, Pfizer, and Johnson and Johnson COVID-19 vaccines had been available to the public for over a year, and vaccination efforts had been widely promoted through incentive programs, and in some cases, government or employer mandates[68]. By this time, approximately 77 percent of US adults had received at least a partial vaccine[68]. Booster shots had only been widely available for about four months, were seldom mandated, and had only been received by 46 percent of vaccinated individuals[69]. For this reason, our findings reflect the broader context in which the initial vaccine had already been integrated into public health efforts, and the primary area of interest had become the adoption of boosters, which were seen as crucial for maintaining immunity, particularly in response to emerging variants like Omicron.

We asked respondents a series of branching questions about the brand and stage of vaccines they obtained. We transformed their answers to an ordinal measure (1 = not vaccinated, 2 = fully vaccinated, e.g., one Johnson and Johnson shot, two Modern or Pfizer shots, 3 = fully vaccinated and boosted). We excluded four partially vaccinated individuals (e.g., one Moderna or Pfizer shot) due to small sample size. We measured vaccine

intentions in 2020, "Would you get a COVID-19 vaccine?" (−3 = *Definitely would not get it*, 0 = *Undecided*, +3 = *Definitely would get it*; $M_{US} = 0.58$, $SD_{US} = 2.16$, $M_{UK} = 1.37$, $SD_{UK} = 1.81$).

Media consumption Respondents were asked to "Consider each of the media outlets below. In general, how much do you get news about COVID-19 from each source?" on a 5-point scale in 2020 (0 = *Not at all*, 3 = *Somewhat*, 4 = *A great deal*) and 7-point scale in 2022 (0 = *Not at all*, 3 = *Somewhat*, 6 = *A great deal*).

In 2020, there were 15 outlets collected in the US: *ABC, AOL, CBS, CNN, Fox News, Huffington Post, MSNBC, NBC, NPR, New York Times, PBS, USA Today, Washington Post, Wall Street Journal*, and *Yahoo! News*. In 2022, we added six outlets: *Breitbart News Network, Daily Wire, National Interest, Reason Magazine, Washington Examiner*, and *Washington Times*. There were eight outlets in the UK in summer 2020: the *BBC, Daily Mail, Guardian Observer, Independent, Daily Mirror, Sun, UK Times*, and *Telegraph*. We collected self-reported consumption from a smaller set of 15 outlets in summer and fall of 2020 based on a blend of popularity, strength of ideological leaning, and availability of third-party ratings from Ad Fontes Media[45], AllSides[60] and YouGov[46] and availability of full-text databases for those outlets. We increased the number of media outlets in 2022 to obtain a broader range of conservative media outlets.

Trust in science In the 2022 survey, we assessed trust in science and in scientists as the average agreement (1 = *Strongly disagree*, 3 = *Neutral*, 5 = *Strongly agree*) with 15 statements such as "We cannot trust science because it moves too slowly" and "We should trust that scientists are being ethical in their work" ($\alpha = 0.94$)[30].

Ideology In summer 2020, we measured ideology as the average of three self-ratings (−3 = *Very liberal*, 0 = *Moderate*, +3 = *Very conservative*) in which respondents reported "How liberal [conservative]…" they were in general, on social issues, and on economic issues ($\alpha_{US} = 0.94$, $\alpha_{UK} = 0.92$). Ideology was not collected in the 2022 survey.

Cognitive reflection Cognitive reflection was measured as the proportion of correct answers ($M = 0.40$, $SD = 0.31$) on six questions designed to elicit incorrect intuitive responses over correct deliberative ones[18].

Conservative media consumption Media ideology ratings were collected from two media organizations: Ad Fontes Media[45] and AllSides[60]. AllSides collects ratings from a global audience that rate media outlets, and Ad Fontes Media uses trained professional analysts. AllSides scores media polarization on a 5-point scale (1 = *Left*; 3 = *Center/Neutral*; 5 = *Right*) that is an average taken from volunteer online raters. Ad Fontes Media reports media polarization (Range [−42 = liberal, 42 = conservative]) on numeric scale using a similar rating procedure.

To calculate respondents' conservative media consumption, we averaged the standardized Ad Fontes Media[45] and standardized AllSides[60] (Supplemental Tables 2 and 4) media polarization ratings for each outlet ($R = .95$). Higher polarization ratings indicate more conservative outlets. We then computed the product of each respondent's consumption rating of that outlet and standardized polarization ratings. For *Yahoo! News* and *AOL*, we took ratings from one outlet. We then summed the products for each respondent and divided that sum by the number of media outlets. This yields an index of the average ideology of consumed media, with negative being more liberal and positive being more conservative in the US ($M_{summer2020} = -0.42$, $SD_{summer2020} = 0.53$; $M_{fall2020} = -0.41$, $SD_{fall2020} = 0.53$; $M_{spring2022} = -0.23$, $SD_{spring2022} = 0.44$) and the UK ($M = -0.01$, $SD = 0.33$). We standardized both conservative tilt of media consumption indices in each wave.

Ideological diversity of media consumption We operationalized ideological diversity of media consumption as the standard deviation of the products of self-reported media consumption and ideological ratings in the US ($M_{summer2020} = 1.09$, $SD_{summer2020} = 0.64$; $M_{fall2020} = 1.05$, $SD_{fall2020} = 0.62$; $M_{spring2022} = 1.42$, $SD_{spring2022} = 1.16$) and the UK ($M = 0.83$, $SD = 0.77$). We standardized ideological diversity of media consumption indices in each wave.

Threat content of media consumption Media content was collected in the US from June 29−August 9 (summer 2020) and from October 30−November 15, 2020 (fall 2020). We took an average for each of the 12 outlets' threat scores in summer 2020 and fall 2020 to create scores for spring 2022. Media content was collected in the UK from June 29−August 9, 2020. We searched for articles that included terms such as "Covid" OR "Coronavirus" and "Covid" + "vaccine". We used LexisNexis[70], an American data analytics company that offers online access to a diversity of news databases, and similar resources to collect articles.

In the US, we collected text from 12 media outlets: *ABC, AOL, CBS, CNN, Fox, MSNBC, NBC, New York Times, NPR, PBS, USA Today*, and *Wall Street Journal* (Supplemental Table 2). Transcripts were of mediums including written articles, radio shows, podcasts, and television broadcasts. For example, in the US we collected text from written articles in the *New York Times*, text from transcriptions of *NPR's* radio show and broadcast of All Things Considered, and text from transcriptions from television broadcasts on *CNN* and *Fox News*.

We analyzed news media data with the Linguistic Inquiry and Word Count (LIWC) automated text-analysis program[62] using the 2022 Threat Dictionary[47], a wordlist comprising of threat terms derived from word embedded models trained on a collection of text such as Wikipedia entries, Twitter posts and news articles[47]. To estimate threat content, we measured the relative frequency of proximal words and synonyms related to threatening language associated with events such as natural disasters and pandemics. Examples include "attack", "crisis", "injuries", "unstable", and "violent"[47]. Since our interest was in creating a linguistic profile for each outlet

rather than the individual content within each outlet, we averaged the texts into a single unit per outlet and used threat scores derived from the outlet level. We calculated respondents' consumption of threat content similar as we did for consumption of conservative media, taking the average of the products of self-reported consumption rating and that outlet's standardized score.

Reliability of media consumption We collected media reliability ratings for 19 different outlets from Ad Fontes Media[45] which captures reliability scores for news outlets that rates on a 65-point scale from "contains inaccurate, fabricated information" to "original, high effort, fact reporting". Moderate scores reflect outlets perceived to be opinion-based or to have variation in reliability and analysis of reporting. The highest scores reflect outlets perceived to have thorough fact-checking and accurate reporting. As a coherence check, we found a significant positive relationship between Ad Fontes Media reliability ratings and YouGov trust ratings ($R = .74$) suggesting news consumers have an intuition for reliable media outlets being more trustworthy outlets. We standardized each measure, computed the product of each respondent's reported media consumption rating and that media outlet's score, and took the average of those products. This yields an index of the average reliability of consumed media, with negative being less reliable and positive being more reliable ($M_{\text{spring2022}} = 0.24$, $SD_{\text{spring2022}} = 0.41$).

Statistical analysis
We conducted analyses with R version 4.2.3. We analyzed data with multiple linear regressions using contrast-coded predictors and their interactions. We present standardized coefficients to facilitate comparability. To test the effect of media consumption on vaccination behavior, an outcome with multiple categories in a hierarchical order, we ran a proportional ordinal logistic regression. All other outcomes were treated as continuous measures using multiple linear regression.

Data availability
Materials, data, and analysis scripts including full results are available on Open Science Framework at https://osf.io/ewr7g/.

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MDG: conceptualization, methodology, formal analysis, investigation of surveys, writing - original draft, writing - review & editing, visualization, project administration. DM: conceptualization, methodology, formal analysis, resources, writing - original draft, writing - review & editing.DS: conceptualization, methodology, formal analysis, resources, writing - original draft, writing - review & editing.AF: conceptualization, methodology, software, investigation of surveys, data curation, project administration.DO: conceptualization, methodology, investigation of media content.EJP: conceptualization, methodology, data curation, writing - review & editing, formal analysis.SD, KE, GMJ, TK, BP, ER, PS, DV: conceptualization, methodology, software, resources, data curation, writing - review & editing, project administration.LVB: conceptualization, methodology, formal analysis, investigation, resources, writing - original draft, writing - review & editing, visualization, supervision, funding acquisition.

Declarations

Competing interests

The authors declare no competing interests.

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