Media evolution and public understanding of climate science

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ABSTRACT. **This paper employs public opinion data from a nationally representative probability sample to examine how information encounters and exposure to different media sources relate to individuals' beliefs about global warming. The analyses indicate that *media source exposure* (i.e., exposure to news and information about science presented through different media outlets), *intentional information exposure* (i.e., deliberate exposure to global warming news coverage), and *inadvertent information exposure* (i.e., unplanned exposure to news and information about science that is encountered online while searching for other forms of information) relate to beliefs about global warming, in significant and meaningful ways. Namely, the findings show that both intentional information exposure and inadvertent online information exposure associate with *disbelief* in human-made causes, catalysts, and consequences of global warming. Theoretical and social implications of the findings are discussed and contextualized in light of the rapidly evolving media environment.**

Key words: Climate science, global warming, public opinion, selective exposure, intentional exposure, inadvertent exposure

Global warming is a transnational environmental crisis that mandates public attention. Yet, public understanding of global warming is divided[1,2,3,4,5,6,7] and substantial proportions of the American public express disbelief in the causes, catalysts and consequences of global warming,[8,9] despite scientific research that thoroughly documents and details humans' role in the phenomenon.[10,11] Drawing from selective exposure theory, this paper explores individuals' exposure to different media sources and examines how intentional and inadvertent information exposure may contribute to public disbelief concerning the role that humans play in the creation, exacerbation, and continuance of global warming.

The terms "global warming" and "climate change" are both commonly used within scientific communities and general populations. From a scientific vantage, global warming is defined by increases in the Earth's average surface temperature due to rising levels of greenhouse gases. It is one aspect of global climate change, which is categorized more broadly as a long-term change in the Earth's climate.[12] The term "global warming" is central to public understanding of climate science because (a) it is used to describe the impact that human activities and greenhouse gas emissions have on global temperatures; (b) it is employed frequently in media discourse surrounding issues of climate science; (c) it draws public attention to issues surrounding climate science; and, (d) it guides the lay public's recall and recognition of the issue topic. [13]

This paper examines four key areas of literature: 1) public understanding of global warming, 2) the media and public understanding of global warming, 3) individual predispositions and public understanding of global warming, and 4) the theory of selective exposure. These literatures are used as the backdrop to approach two central research questions: First, when controlling for individual predispositions, does exposure to different media sources relate to disbelief in the causes of global warming, the primary catalysts of global

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warming, and/or the resulting consequences of global warming? Second, when controlling for individual predispositions, how do intentional and inadvertent forms of information exposure relate to disbelief in the causes of global warming, the primary catalysts of global warming, and the resulting consequences of global warming?

It is important to note that this study does not focus on typical aspects of information exposure and attitude consistency introduced in previous studies of selective exposure and attitude reinforcement.[14] While studies of selective exposure often focus on *what* types of information audiences encounter, this paper focuses on *where* audiences go for information (i.e., which media sources they select) and *how* they encounter information, through intentional and inadvertent forms of exposure. This study, therefore, builds on selective exposure theory by isolating two aspects of exposure – media source exposure and intentionality of information exposure. It then takes these factors into account as potential mechanisms underlying public understanding of global warming.

Public understanding of global warming

Public understanding of global warming is puzzling. While base levels of issue awareness have increased overtime,[7] so too have the number of individuals (*disbelievers*) who do not recognize an anthropogenic link to global warming. In a 2003 Gallup poll, under one-third of respondents expressed agreement with the statement that, "Increases in the Earth's temperature over the last century are due more to natural changes in the environment than are due to human activities." By 2007, this number increased to over 35 percent [15] and by 2010 it had risen to 46 percent.[16] With such sizeable amounts of disbelief in the anthropogenic link to global warming, the mechanisms driving the public's disbelief necessitate further inquiry.

Multiple forms of disbelief have been identified in the literature.[8] Yet, aspects of disbelief have yet to be evaluated comparatively. This research examines different aspects of public disbelief, specifically, disbelief in the *causes*, *catalysts*, and *consequences* of global warming. Public understanding of each of these issues can fluctuate;[7] and since, the mechanisms underlying public perceptions of global warming are not fully understood, investigation is warranted. In this paper, public disbelief in global warming is approached as a multifaceted concept defined by: those who do not believe that human-made factors *cause* global warming, those who dismiss *catalysts* that drive global warming, and those who do not recognize the *consequences* that global warming has on the environment.

The media and public understanding of global warming

As a key conduit between scientific communities and the public at-large, news media play a crucial role in the dissemination of information.[17,18] As such, news organizations have the potential to facilitate public discourse and enhance public understanding;[19] to undergird issue cycles and drive fluctuations in public understanding;[20] or, conversely, to exacerbate gaps in knowledge and increase disparities in public understanding.[21,22,23] When covering climate science, journalists can frame issues surrounding global warming in ways that present conflicting viewpoints and highlight contention.[24]

Arguably, competing frames can be employed to promote public debate and discourse; however, competing frames often extend politically charged ideological cues that play upon partisan views and polarize public opinion.[25] Furthermore, media frames that work to uphold a sense of balance and objectivity by highlighting uncertainty in scientific understanding can actually lead to a larger sense of public confusion.[26,27] Some have argued that the competing frames presented in mainstream mass media have shifted overtime from high levels of uncertainty to greater levels of consensus, with mainstream news coverage that portrays less "false balance." [28] Whether mainstream media frames are actually unifying is debatable; however, one trend is certain: the numbers of Americans who are receiving their news solely from traditional mainstream mass media is decreasing and the turn toward the web as a source of news and information is on the rise.[29]

When viewed broadly, the media environment is continually evolving and expanding in ways that present individuals with increasing choice about where to go for information. During this time of rapid growth and transformation, the information landscape has developed to provide news audiences with abundant opportunity to select between many different types of media outlets and to perhaps selectively choose outlets and news coverage that fits with their individual predispositions.

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Individual predispositions and public understanding of global warming

Individual predispositions are key determinants of beliefs about politicized scientific issues such as global warming,[30,31] and in relation to individuals' selection of media, may play a role in driving public disbelief surrounding global warming.[32,33] Political ideology and religiosity have been identified as predispositional factors that play an important role in shaping public understanding of politicized science. Recent research finds that political ideology is closely linked to beliefs about global warming, where ideological conservatives are more doubtful of the anthropogenic link to global warming than li' erals.[31] Additionally, studies that examine the contextual significance of religious orientation suggest that religiosity can serve as a cue that guides public understanding of science,[34,35] where high levels of religiosity may signal an increased likelihood of identifying environmental changes to be God-driven occurrences.

Selective exposure theory

The theory of selective exposure provides a relevant theoretical lens to further explore how individuals' predispositions, media choices, and information exposure patterns can influence beliefs about global warming. The selective exposure hypothesis contends that individuals seek out information based on their existing predispositions.[36,37] Selective exposure trends have been documented with respect to patterns of information exposure, attention, and interpretation.[38,39] These studies focus on how people encounter and interpret political information, and provide reason to suspect that media consumers intentionally attend to certain media outlets, while deliberately avoiding others.

In other words, selective exposure choices are not limited simply to the types of information individuals seek—they also include the type of media sources audiences are exposed to and can be defined by the ways in which individuals encounter information. As such, information exposure processes can be observed through both intentional (deliberate) exposure and inadvertent (unplanned) exposure to information.

Intentional information exposure requires a motivated audience—it is issue specific; guided and controlled by the individual searching for the information; and, as the selective exposure hypothesis would predict, may be more likely to result in exposure to information that reinforces rather than challenges existing attitudes.[39] Inadvertent information exposure, on the other hand, is less certain but increasingly common; it occurs when an individual unexpectedly encounters information within a certain domain (e.g., science) while searching for information in a different domain (e.g., politics). Inadvertent information exposure is notable in web-based environments where an individual unexpectedly "stumbles into" news and information about science while simply browsing the web for other forms of news and information.

With respect to the selective exposure hypothesis, the self-guiding nature of the web may work to steer individuals toward information that further reinforces their existing views.[40] By pushing search returns toward information that is tailored toward the web user's previous searches, such tailored suggestions could conceivably *reinforce disbelief* among those who are already doubtful. Alternately, the web's increased allowance for unanticipated encounters with science information[41] could potentially *increase factual knowledge* about issues such as global warming—an inadvertent information gain could conceivably manifest in lessened public disbelief. Although these possible outcomes are competing, both provide reason to suspect that inadvertent information exposure might hold significant associations with individuals' beliefs (and levels of public disbelief) in issues connected to global warming.

Research questions

With respect to the evolving media environment and the increasing variety of media sources available to the American public, many factors, including individual predispositions, media source exposure, intentional information exposure, and inadvertent information exposure, could factor into public disbelief about aspects of global warming. Additionally, because information can be both intentionally sought out, as the selective exposure hypothesis suggests, and inadvertently acquired while looking for other forms of information, studying information exposure in intentional and inadvertent forms may provide a more nuanced understanding of media impact.

To structure the analysis, two research questions that examine public disbelief are asked.

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RQ1: When controlling for individual predispositions, does exposure to different media sources relate to disbelief in (a) causes of global warming, (b) primary catalysts of global warming, and (c) resulting consequences of global warming?

RQ2: When controlling for individual predispositions, how do intentional and inadvertent forms of information exposure relate to disbelief in (a) the causes of global warming, (b) primary catalysts of global warming, and (c) resulting consequences of global warming?

Method

Sample

The Exploratorium Survey from the Internet and American Life Project is employed to address the primary research questions. The sample for the survey was selected from telephone exchanges in the continental United States. Survey participants were selected via probability sampling techniques and were recruited using random digit dialing procedures. The random digit aspect of the sample was used to avoid listing bias and provides representation of both listed and unlisted numbers, including not-yet-listed numbers. The design of the sample achieved this representation by random generation of the last two digits of telephone numbers selected on the basis of their area code, telephone exchange, and bank number.

The interviews were conducted by telephone between January 9 and February 6, 2006, among a sample of 2,000 adults, 18 and older. At the time the survey fielded, the characteristics of the sample closely resembled those of the broader U.S. population. The response rate for the survey, calculated in accordance with The American Association for Public Opinion Research (AAPOR) guidelines, was 30 percent.

The dataset contains measures that capture key concepts central to the research questions, including individual predispositions, exposure to different media sources, and intentionality of information exposure. With respect to the guiding research questions, the key concepts are assessed using multivariate logistic regression models to discern how media source exposure and intentionality of information exposure play into beliefs about global warming, while controlling for other principle covariates.

Analytic approach

In a series of regression models (see Tables 1–4), individual predispositions, exposure to different media sources, and intentional and inadvertent forms of information exposure are positioned as potential predictors of disbelief about global warming, including disbelief in an anthropogenic cause (Table 1), catalyst (Table 2), and related consequences (Tables 3 and 4). In each regression model, disbelief is measured as a dichotomous variable, i.e., disbelief is coded high and belief is coded low.

Criterion variables

Disbelief in causes, catalysts, and consequences of global warming

The first type of disbelief concerns disbelief in the *cause* of the phenomenon. In assessing this form of disbelief, respondents were asked the following question: "In general, do you think that … (a) global warming is the result of natural changes in the Earth's atmosphere or that (b) global warming is the result of human activity? Selection of natural causes rather than human-made causes was coded high to denote disbelief in *anthropogenic* cause.

The second type of disbelief concerns disbelief in the *catalysts* that fuel and exacerbate global warming. This question looks at the interaction between deforestation and environmental cost, asking "Do you think that deforestation is a contributing cause of global warming?" Disagreement with the statement, an expression of disbelief in a primary *catalyst* of global warming, is coded high with belief in the statement coded low.

The third type of disbelief concerns disbelief in the environmental *consequences* of the phenomenon. This concept is approached through two distinct measures: the first a broad, overarching outcome concerning changing weather patterns and the second a more specific, tangible outcome concerning the melting polar ice caps. The first measure is captured through the question, "In general, do you think that global warming is already causing more severe weather patterns across much of the planet?" The second measure is captured through agreement or disagreement with the statement, "Scientists have confirmed that the Arctic polar ice cap is melting." Both variables are evaluated as dichotomous (yes/no) measures.

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Disbelief ("no") is coded high in the regression analyses, while "yes" is coded low.

Exogenous variables

Predespositions, media source exposure, and intentionality of information exposure

The analyses model three batteries of questions that predict disbelief. The first is a battery of core demographics and predispositions, including age, political ideology, income, gender, and religiosity.

Predispositions

Because individual predispositions can influence individual understanding of scientific issues,[36,37] the analyses control for key demographics, including age, political ideology, income, gender, and religiosity. Age is measured in years (M = 45.89; SD = 17.86). Political Ideology (M = 3.63; SD = 2.03) is assessed on a 5-point scale, where "very liberal" is coded low (1) and "very conservative" is coded high (5). Income (M = 4.84; SD = 2.23) is normally distributed across eight incremental categories, with 1 being less than $10,000 and 8 indicating $100,000 or more. Gender (51.8 percent female, 48.2 percent male) is introduced into the analyses as a dichotomous variable, where female is coded high. Finally, religiosity (M = 2.72; SD = 1.33) is captured through a measure of frequency of attendance at a place of worship on a 5-point scale, where 1 denotes less frequent attendance and 5 denotes more frequent attendance.

Media source exposure

The second battery of questions relates to *media source exposure*. The questions ask participants if they get science news and information from different media sources, including newspapers, television, magazines, radio, and the web. With this multiple response item, respondents are able to select as many outlets as applicable. For each media source selection, "yes" is coded high, and "no" is coded low.

Intentionality of exposure

The third battery of questions captures intentionality of information exposure. The models incorporate two measures: *intentional exposure* to global warming news coverage and *inadvertent exposure* to science-related information acquired online while using the web for other purposes. The intentional exposure measure captures deliberate exposure to news about global warming and is measured on a 4-point scale that reads, "How closely do you follow stories about global warming and climate change—very closely, fairly closely, not too closely, or not at all closely?"

The measure of inadvertent exposure captures unplanned exposure to news and information presented through web-based sources. The focus is directed toward online sources because the web is an information conduit that allows clear opportunity for information exposure to be inadvertently acquired. The inadvertent exposure measure asks, "When using the Internet, do you ever come across science news and information when you may have been going online for some other purpose?" Exposure ("yes") is coded high.

Results

Descriptive statistics reveal mean differences between believers and disbelievers on all modeled predispositional covariates. On the measure of disbelief in anthropogenic cause, where disbelievers are those who believe the phenomenon is natural and believers are those who believe global warming is the result of human activity, significant differences arise with respect to age, political ideology, income, and religiosity. Specifically, mean comparisons show that older respondents are more likely to express disbelief than younger respondents (t = 5.833, $p < .001$). Those who identify as more conservative express more disbelief than those who identify as more liberal (t = 3.565, $p < .001$). Those of higher income express more disbelief than those of lesser income (t = 2.610, $p < .001$). And, those who report higher levels of religiosity are more likely to identify a natural cause than an anthropogenic cause (t = 4.766, $p < .001$). Mean differences offer a general indication of predispositional differences across groups.

A series of logistic regression models are next introduced to target predictors of disbelief toward aspects of global warming, in regard to the phenomenon's *causes*, *catalysts*, and *consequences*.

The first regression examines disbelief regarding the origins and primary *cause* of global warming (see Table 1). When controlling for predispositional factors, higher levels of income (B = .069, $p < .01$) and religiosity (B = .087, $p < .05$) are significantly

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Table 1. Disbelief in global warming's primary origins/causes *"Global warming is the result of NATURAL changes in the Earth's atmosphere..."* (Disbelief in anthropogenic cause coded high)

	B	*SE B*		*B*	*SE B*
Predispositions			*Media source exposure*		
Age	.000	.004	Television	−.822***	.215
Political ideology	−.015	.033	Newspapers	.160	.154
Income	.069**	.028	Magazines	−.083	.136
Sex	−.144	.133	Radio	−.199	.144
Religiosity	.087*	.045	Web	.165	.126
			Intentionality of information exposure		
			Intentional exposure	.304***	.079
			Inadvertent exposure	−.100	.097

Note: ***$p < .001$, **$p < .01$, *$p < .05$

Model $F = 3.984$, $p < .0001$, $R = .189$, $R^2 = .036$

Table 2. Disbelief in global warming's catalysts *"Deforestation is a contributing cause of global warming..."* (Disbelief coded high)

	B	*SE B*		*B*	*SE B*
Predispositions			*Media source exposure*		
Age	.003	.006	Television	−.955***	.282
Political ideology	.188***	.043	Newspapers	−.518***	.202
Income	−.053	.037	Magazine s	.364**	.177
Sex	.497***	.174	Radio	.884***	.188
Religiosity	−.031	.059	Web	.152	.164
			Intentionality of information exposure		
			Intentional exposure	.795***	.103
			Inadvertent exposure	−.141	.127

Note: ***$p < .001$, **$p < .01$, *$p < .05$

Model $F = 13.386$, $p < .0001$, $R = .333$, $R^2 = .111$

Table 3. Disbelief in global warming's consequences *"Scientists have confirmed that the Arctic polar ice cap is melting..."* (Disbelief coded high)

	B	*SE B*		*B*	*SE B*
Predispositions			*Media source exposure*		
Age	−.014***	.004	Television	−.510**	.217
Political ideology	.046	.033	Newspapers	−.032	.155
Income	−.011	.028	Magazine s	−.127	.136
Sex	.511***	.134	Radio	.561***	.145
Religiosity	−.044	.045	Web	.367***	.126
			Intentionality of information exposure		
			Intentional exposure	.686***	.079
			Inadvertent exposure	.223**	.098

Note: ***$p < .001$, **$p < .01$, *$p < .05$

Model $F = 8.854$, $p < .0001$, $R = .376$, $R^2 = .141$

Table 4. Disbelief in global warming's consequences *"Global warming is already causing more severe weather patterns across much of the planet..."* (Disbelief coded high)

	B	*SE B*		*B*	*SE B*
Predispositions			*Media source exposure*		
Age	.010***	.004	Television	−.176	.191
Political ideology	.019	.029	Newspapers	.057	.137
Income	.051**	.025	Magazine s	.092	.120
Sex	.092	.118	Radio	.043	.128
Religiosity	−.140***	.040	Web	−.172	.112
			Intentionality of information exposure		
			Intentional exposure	.360***	.070
			Inadvertent exposure	.336***	.086

Note: ***$p < .001$, **$p < .01$, *$p < .05$

Model $F = 6.526$, $p < .0001$, $R = .240$, $R^2 = .057$

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associated with an increased likelihood of believing global warming to be a sign of "natural" changes in the earth's atmosphere. Exposure to scientific information via television is associated with lower levels of disbelief, i.e., the likelihood of attributing global warming to natural causes, rather than man-made factors, was less among those exposed to science information on television ($B = -.822$, $p < .001$). With respect to audience intentionality, a greater level of self-guided, deliberate exposure to news coverage about global warming corresponds to an increased likelihood of dismissing an anthropogenic cause ($B = .304$, $p < .001$).

The second regression looks at disbelief regarding a primary *catalyst* of global warming (see Table 2). The model shows that ideological conservatism is associated with increased disbelief in the link between deforestation and global warming ($B = .188$, $p < .001$). The results also indicate that those exposed to scientific information through mainstream media, namely, television viewers ($B = -.955$, $p < .001$) and newspaper readers ($B = -.518$, $p < .001$) are more likely to recognize that deforestation is a contributing catalyst of global warming. On the other hand, those exposed to science news and information through magazines ($B = .364$, $p < .01$) and radio ($B = .884$, $p < .001$) are more likely to express disbelief. A greater level of intentional exposure to news coverage about global warming (i.e., the attitude reinforcement hypothesis) also aligns with disbelief towards deforestation as a catalyst of global warming ($B = .795$, $p < .001$).

The third regression (see Table 3), which examines disbelief toward a major *consequence* of global warming (the melting of the Arctic polar ice cap), shows that disbelief is inversely related to age ($B = -.014$, $p < .001$). Media exposure variables indicate that exposure to scientific information from television is associated with lower levels of disbelief ($B = -.510$, $p < .01$), while information exposure through radio ($B = .561$, $p < .001$) and use of the web ($B = .367$, $p < .001$) correspond to higher levels of disbelief. Both intentional exposure to news coverage about global warming ($B = .686$, $p < .001$) and inadvertent exposure to news and information about science acquired while using the web ($B = .223$, $p < .01$) are positive predictors of disbelief.

The fourth regression on disbelief (see Table 4), which examines a major *consequence* of global warming—the proposition that "global warming is already causing more severe weather patterns across much of the planet" – shows that disbelief (expressing that global warming is not influencing weather patterns) increases with income ($B = .051$, $p < .01$) and age ($B = .010$, $p < .001$). Those who frequently attend a place of worship are less likely to express disbelief about global warming's influence on weather patterns, i.e., they are more likely to acknowledge global warming is causing severe weather patterns ($B = -.140$, $p < .001$), which is not incongruous with earlier findings, and may actually be a function of the belief that global warming origins are "natural." Both intentional exposure to news coverage about global warming ($B = .360$, $p < .001$) and inadvertent exposure to news and information about science acquired while online ($B = .336$, $p < .001$) also predict disbelief about the effects that global warming has on weather patterns.

Discussion

In response to the first research question, across all models, the media source(s) through which information about science is encountered often relates significantly to individuals' level of disbelief in issues surrounding the anthropogenic causes, catalysts, and consequences of global warming. In keeping with the selective exposure hypothesis, and in response to the second research question, the analyses show that audience intentionality, particularly with respect to the deliberate following of global warming news, is associated with disbelief. Additionally, the findings suggest that inadvertent exposure to science-related news and information that is unexpectedly encountered in web-based environments is associated with disbelief in the anthropogenic link to global warming.

Why do intentional forms of information exposure associate with disbelief? Although the analyses do not test for attitude consistency or change before and after information exposure, the findings are in keeping with selective exposure theory, which suggests that audiences seek out information outlets and follow news sources that are congruous with individual predispositions. This is evidenced in part by the predispositional factors that correlate most notably with disbelief, including political ideology. The outcome echoes previous studies that suggest ideological conservatives are more likely to express doubt about global warming than ideological liberals,[30] a position that may be reinforced by exposure

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to partisan media.[31] The analyses reported here suggest that when ideology and preferred media source exposure are examined simultaneously, both play active, yet independent, roles in relation to the expression of disbelief. Interestingly, when both factors are controlled for, the role that income plays in establishing disbelief remains significant.

Why is it that those with higher levels of wealth express more disbelief in the anthropogenic origins of global warming? One possibility may derive from a desire to maintain cognitive consistency and minimize dissonance, whereby acknowledging the human-made origins of global warming could require shifts in attitudes, beliefs, and behaviors to which those of higher income are already socially or economically invested. Further, those with higher earnings may have relatively high degrees of satisfaction and contentment with their current social and economic investments and may, therefore, be reticent to accept positions that they perceive to work against their self-interests.[42,43] By acknowledging global warming and accepting responsibility for potentially playing a role in the phenomenon, existing beliefs, behaviors, and spending patterns might need to be modified, which could cause personal discontentment.

Additionally, with respect to ideologically driven media preferences, upper income respondents may be more likely to hold conservative ideologies, and may therefore expose themselves to more conservative media that transmit hostile messages about global warming, which could further propagate disbelief. Fluctuations in the signs of beta coefficients across the reported regression models are suggestive of such interactions.

The relationships between religiosity and disbelief also manifest in interesting ways. In keeping with past research on the role of religiosity in public understanding of science,[34,35] highly religious respondents were more likely to attribute global warming's origins to "natural" factors rather than human-made forces, and were additionally more likely to accept global warming's link to weather change. However, they were not significantly more likely to express disbelief in the role that deforestization plays in driving global warming, which suggests that while religious individuals may attribute global warming's origins to "God-driven" factors, they are not less likely to dismiss a "human-driven" behavior that can exacerbate global warming.

The strong, positive correlations between expressions of disbelief and intentional exposure to information about global warming across all of the regression models suggest that disbelief and deliberate exposure to global warming news coverage are significantly linked. Whether information exposure is establishing or reinforcing disbelief is an important question of temporal ordering that requires further attention in studies that are able to capture attitude consistency or change by measuring beliefs before and after source exposure.

The strong tie between intentional exposure and disbelief may also reflect a larger correspondence between segmenting media outlets and polarized beliefs systems, where existing beliefs are supported and perpetuated through use of media outlets that are tailored to fit audience predispositions.[44] Parallel conclusions are reached in this study, where the correspondence between source exposure and disbelief manifests most notably with respect to media outlets that tend to be tailored toward specific audiences (e.g., radio, magazines, and the Web). These associations suggest that exposure to segmented media sources may be associated with beliefs about global warming.

Segmented media outlets are information conduits that provide multiple channels of information, which in turn allow marketers and advertisers to narrowcast content in order to attract specific audience shares.[45] Researchers identify magazines, radio, and the Internet as examples of segmented media outlets and contend that segmented forms of media are more likely to carry news that is tailored or targeted toward users' existing interests.[40] Because segmented news outlets tend to host content that is created to mirror users' predispositions, segmented forms of media may be more likely to carry content that projects ideological slant which reinforces existing beliefs,[32,33] about highly politicized issues like global warming. In future research, more detailed measures of media source segmentation could be introduced to further test fragmentation hypotheses.

In dialogue with research suggesting that the web allows for multiple forms of information exposure that are intentionally guided by the predispositions of the individual user,[40,46] and perhaps also unintentionally reinforced by the nature of the technology, the outcomes of this study show that the relationships between web use and disbelief manifest in a complex manner, through both intentional and inadvertent exposure to information.

Interestingly, significant ties between web searching and disbelief in consequences of global warming (i.e.,

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melting polar ice caps and influence on weather) are found with respect to inadvertent exposure to information about science that is acquired while online for other purposes. Why is this the case? When searching for information online, web-based technologies allow users to conduct information specific topic searches. Additionally, the technology can direct information to users that is guided by previous information searches, as is the case with Google's algorithm. In other words, the web may allow users to actively seek information about global warming that aligns with existing beliefs—and, search engines may provide tailored information returns that further reinforce existing disbelief. This invisible echo-chamber effect could be particularly influential among those who are skeptical or uncertain about specific issues, and among those with strong predispositions and ideologies, which could increase the likelihood of exposure to partisan information. These explanations also warrant further investigation that examines the ideological valence of specific news sources in tandem with audience exposure and attitude consistency over time.

Summary and significance

The results of this study indicate that media source exposure and different types of information exposure are important and significant determinants of individual beliefs about global warming. The outcomes complicate the notion that selective exposure processes consist solely of intentional information exposure. Indeed, inadvertent information exposure, guided by web-based media technologies, also plays a significant role in shaping beliefs. Because the information that audiences are exposed to online can be driven and guided by the structure and nature of search engines and web portals,[47] as well as the structure and nature of the search terms employed and the specific websites frequented,[48] it is quite possible that some audiences selectively expose themselves to information about global warming by actively seeking out topic-relevant information. Others may, however, "stumble into," or unintentionally encounter information about global warming that is circulated through the hyper-individualized nature of the web. The web, in other words, is a complex, networked system that guides information exposure, which can directly and indirectly reflect and reinforce existing user attitudes.

As audiences' use of information technologies continues to evolve, more work in this area will further enrich our understanding of the implications that an ever-changing media environment has on audience understanding. Technological developments need to be evaluated alongside scientific developments in order for researchers to understand how the public understands science. Future research should continue to monitor these relationships both longitudinally and across geographical boundaries.

It is also important to note that the dichotomous media exposure measures employed in the analyses provide a conservative estimate of media impact. They are employed because the study is directed at a representative sample, i.e., the general public in the U.S., where exposure to information about science is limited, particularly in comparison to scientific communities, interest groups, and specific issue publics where exposure can be far greater. To garner more robust measurement of audience engagement and media impact, more expansive measures of information exposure should be introduced to simultaneously explore both frequency of source use and audience attention patterns.[49,50]

Social implications

When viewed in a larger social context, the findings show that beliefs about anthropogenic global warming are guided by individuals' predispositions and may be perpetuated by information gleaned through media systems. Within heated political climates, where political actors attempt to strategically capitalize on media systems as a means to extend partisan agendas, disbelief among misinformed publics may be exacerbated. Alternatively, however, in media environments where accurate scientific information is privileged over politicized messaging biases, the opportunity for audiences to acquire accurate information about science may be extended—and well-informed beliefs about anthropogenic global warming forwarded.

Ultimately, public understanding is best served within a "clean media environment" that promotes scientific evidence over political rhetoric. Toward such ends, the cultivation of scientific understanding requires commitment from journalists and scientific communities to ensure that political pressures do not compromise the information that the public encounters.

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