frontiers | Frontiers in Communication

TYPE Original Research
PUBLISHED 15 December 2022
DOI 10.3389/fcomm.2022.1052277

OPEN ACCESS

EDITED BY
Amy May,
University of Alaska Fairbanks,
United States

REVIEWED BY
Rita Gill Singh,
Hong Kong Baptist University, Hong Kong SAR, China
Rebecca Kauten,
Iowa Lakeside Laboratory Regents Resource Center, United States

*CORRESPONDENCE
Adam M. Rainear
arainear@wcupa.edu

SPECIALTY SECTION
This article was submitted to Science and Environmental Communication, a section of the journal Frontiers in Communication

RECEIVED 23 September 2022
ACCEPTED 28 November 2022
PUBLISHED 15 December 2022

CITATION
Rainear AM and Lachlan KA (2022) The station scientist: Examining the impact of race and sex of broadcast meteorologists on credibility, trust, and information retention.
Front. Commun. 7:1052277.
doi: 10.3389/fcomm.2022.1052277

The station scientist: Examining the impact of race and sex of broadcast meteorologists on credibility, trust, and information retention

Adam M. Rainear[1]* and Kenneth A. Lachlan[2]

[1]Department of Communication and Media, West Chester University of Pennsylvania, West Chester, PA, United States, [2]Department of Communication, University of Connecticut, Storrs, CT, United States

Broadcast meteorologists hold a set of skills unique in a newsroom. Not only must a broadcast meteorologist utilize communication skills similar to that of a newscaster, they are also typically versed in some physical science. In addition, the field of meteorology has an unfortunate disparity when examining job statistics as they relate to race and biological sex. Generally speaking, men outnumber women in broadcast television positions three to one, and minorities are often outnumbered or excluded from coverage altogether. Drawing on Uses and Gratifications and Media System Dependency Theory, this project examined the effects of race and biological sex on the audience perceptions of forecaster trust, credibility, and information retention. Two experiments were conducted, and analysis of variance was utilized to examine the hypotheses and research questions. The first experiment tested the manipulations of forecaster race and sex in the form of a mock weather hit – using a student sample. The results generally suggest that there are mixed findings for the effects of forecaster race and sex on the dependent variables of trust, credibility, and information retention. The second experiment tested the same two manipulations from experiment one on a non-student sample. The results are discussed in terms of how individuals may perceive forecasters given their race, sex, or degree level, and the potential implications for processing information or forming attitudes and decisions based off this behavior.

KEYWORDS

broadcast meteorology, credibility, trust, race, broadcast news

Introduction

"Americans have long looked to the 'weatherman' to keep them informed on the atmosphere's itinerary. In the first few years of television, a new medium gave people exactly what the word weatherman implies: a man, and usually a white one" (Henson, 2013, p. 109). Often dubbed the "station scientist," broadcast meteorologists hold a unique set of skills relative to the remainder of a broadcast newsroom; most positions in the field of news and broadcasting focus on training individuals with skills necessary for public speaking, television scriptwriting, and journalistic ethics. Meteorologists in the field of broadcasting require the similar skillsets to a newscaster: relaxed, conversational, and enthusiastic (Mirsky, 2000); yet these skills must be uniquely coupled with physical science knowledge, including atmospheric dynamics, physics, radar meteorology, and other related science fields (Henson, 2013).

Early work on the effectiveness and reach of weather broadcasts found that individuals turn to them for a wide-range of science information and education – ranging from the less obvious in geography (Earl and Pasternack, 1991) and public health issues (Joinson, 2008), to the less surprising in that of risk information about natural disasters such as hurricanes (Demuth et al., 2012) or information on climate change (Zhao et al., 2014). Since weather events are one of the largest risks to society – both economically and as a health and safety risk – understanding if differences of forecaster appearance, more specifically sex and race, influence audience perceptions is important to both researchers and those who may be attempting to mitigate against some risk (Collins, 2018). More explicitly, understanding if trust, credibility, and retention of information are influenced among an audience dependent on whether the broadcast meteorologist is white or black, and male or female, can help researchers and practitioners better understand the biases and limitations which individuals have in processing and considering weather forecasts and warning messages. Unfortunately, there is a substantial disparity between men and women, and different racial groups, when breaking down the job statistics of positions held in the field of meteorology (Gonzales, 2010; Maibach et al., 2011, 2017; Malone, 2011; Green et al., 2019).

Generally speaking, both racial minority groups and women are outnumbered in the field of atmospheric science – which is also the case in a variety of other STEM domains as well (Avolio et al., 2020). More specifically, females are outnumbered by males in terms of overall positions held, and this trend is especially present in broadcast positions. Polling has suggested that ∼25% or fewer of local television weather positions are held by women (Cranford, 2018), and this rate has remained relatively constant over the last twenty years. During their surveys of broadcast meteorologists' views on climate change, Maibach et al. (2011, 2017) have found females comprise 18–25% of positions, with others finding ∼20% of local positions being held by women (Malone, 2011). Unsurprisingly, this figure is even lower for those in prominent positions, with 10–12% of local news stations having females holding the chief meteorologist position (Malone, 2011). This trend also spans into the field of meteorology more generally, as women typically comprise 15% of all professional roles in meteorology, which can include government, academia, private sector, and non-profits (among others; Gonzales, 2010).

Racial demographics of broadcast meteorologists paint an even more bleak picture. Though not specifically meteorology (the fields of meteorology and climatology are closely related, falling under the umbrella of atmospheric science), a 2017 analysis of broadcast network Sunday morning shows by *Media Matters* found that only 13% of guests or contributors to climate-related segments were from minority racial groups. In 2016, only one member of a racial minority group appeared on these same broadcast network shows to discuss climate, which is extremely concerning considering it was a United States presidential election year (Kalhoefer, 2018). In broadcast news more generally, a 2004 survey of local television stations found that only about 10% of the broadcast news workforce was black (and being less than 4% of news directors for the stations; Papper, 2005). For comparison, the entire United States population is made up of ∼40% non-white individuals. In the same analysis, women constituted 29% of the guest appearances on the Sunday morning broadcast network shows, while the breakdown of men and women in the United States is much closer to a 50/50 split.

While the underrepresentation of certain groups is problematic enough in itself, the hegemonic, male-dominated ideas which permeate broadcast meteorology and science at-large can lead to inaccuracies or poor representations. For example, the "weather girl" stereotype, popularized in the 1950s (Malone, 2011; Henson, 2013) arose out of an increase in presentation gimmicks which were used in broadcast news and journalism during this early age of visual broadcasts. This stereotype, one of which views women as unable or less able to understand science (Flicker, 2003; National Academy of Sciences, 2007; Brann and Himes, 2010; Henson, 2013), is often reinforced in various media forms (Perryman and Theiss, 2014) and could lead to a disconnect between viewers perceptions of the forecast with respect to the broadcast meteorologist's intelligence, credibility, and trust (Brann and Himes, 2010). Coupling this with a fact like women being expected to cover softer news stories (compared to harder news topics; Desmond and Danilewicz, 2010), serves only to further reinforce these inaccurate stereotypes. Furthermore, the connotation in using the word "girl" – when many times male counterparts are described as "men" – suggests a child-like or novice knowledgebase when describing women broadcast meteorologists. Since credibility and trust are important considerations when the public determines appropriate response to dangerous weather (Trumbo and McComas, 2003;

Sherman-Morris, 2005; Siegrist et al., 2005; Lachlan et al., 2014; Spence et al., 2014), an attenuation of trust based solely on biological sex, appearance, or racial demographic is a dangerous slope to navigate. The desire for television weather forecasts, particularly those which focus on local coverage and impacts, will remain steadfast and useful, and understanding sex and race differences toward individuals in this community will also remain important.

Knowing that individuals consume media to meet a variety of goals - such as information seeking, entertainment, or as a distraction – there exist numerous approaches which can guide research interested in the effects of consuming some media. Similarly, one must consider the context of media consumption as well, since media consumption does not exist in a vacuum with no societal context or considerations, especially when considering science and weather information specifically. Two such approaches, Uses and Gratifications (U&G), and Media System Dependency (MSD; alternatively called Media Dependency Theory) examine the relationships between audience desires and needs and the media which is consumed. Both frameworks are outlined and presented as guides for forming the research questions in this present study.

Uses and gratifications framework

Uses and gratifications theory (U&G) is used to understand how an audience selects and uses mass media to obtain specific social and psychosocial needs and goals, to understand media consumption motives, and to identify consequences or functions which result from media consumption or behavior (Katz et al., 1973). In other words, the behavior of an individual within the audience is goal-orientated and contains some purpose, and which media individuals choose to select are used to fulfill these goals, needs, wants, or expectations (Rubin, 2009).

Some of the more common uses for mass media are centered around five types of human needs. First, humans have a need for cognition, which can be satisfied through knowledge-based activities and learning with media. Second, individuals may seek to gratify an affective need through emotional and enjoyable experiences with media. Further, individuals develop a personal identity through media use, confidence building, social status, and impression management. This helps build the integrative need of media, in other words helping individuals build their social identity through modeling behavior. A similar need for social integration is also desired and performed through social connections in the real world (or on virtual platforms) which we can feel a connection with others around the same topic (i.e., Tweeting with others about the same television character, etc.). Finally, many users desire escapism as a need derived from media – such as removing oneself from the real-world because of an unpleasant experience or overwhelming feeling – or in the form of experiences that one cannot reasonably partake in (e.g., watching an astronaut walking on the moon; Lin, 1999; Rubin, 2009).

Williams et al. (1985b) noted that U&G was mainly applied to traditional mass media research, but new media and the current technological boom have afforded researchers further extensions to apply these suggested U&G frameworks. U&G research has expanded to investigate motives for the internet (Papacharissi and Rubin, 2000) and to constructs within the internet such as MP3 music (Ferguson et al., 2007; Zeng, 2011), YouTube (Haridakis and Hanson, 2009), social networks (Joinson, 2008), online newspapers (Yoo, 2011), and Twitter (Liu et al., 2010). Early research which applied U&G theoretical frameworks to internet usage (Kaye, 1998; Ko, 2000; LaRose et al., 2001; LaRose and Eastin, 2004; Ko et al., 2005) generally finding low correlations between web usage and entertainment, social interaction, and escape gratifications (r ranges from 0.17 to 0.30). Similar studies have found results where classic mass media motivations (surveillance; escape, companionship, identity, and entertainment) accounted for 47% of the overall variance of the likelihood to adopt online technology (Lin, 1999). College students specifically information seek using the web for a variety of reasons, but the students do not always consider information they find as credible (Metzger et al., 2003). Since the internet is such a large-scale platform which has a variety of uses, this natural variety of uses allows for an even more diverse set of gratifications for the individual user to achieve (Ruggiero, 2000).

Some scholars argue that internet and cell phones can be classified as neither a mass communication platform nor a specific-individual medium for all situations (Morris and Ogan, 1996). This could be partially attributed to the fact that the aforementioned media can be used both interpersonally and for large-scale mass communication (Wei, 2008). Rubin (2009) postulates that U&G is useful for understanding today's more interactive media environment, through refinement of original U&G measures (scales) and more parsimonious investigations of gratifications which arise out of technological affordances. Early work on mobile phone U&G focused primarily on using cellular phones as solely talking devices, with much of the research focused on cell phone U&G being drawn from conventional telephone usage research. Some common motives found in traditional phone usage included functional and relational motives (Claisse and Rowe, 1987), fun or entertainment (Williams et al., 1985a), and reassurance or fulfilling a need for security (Dimmick et al., 1994). More recent studies have attempted to capture the U&Gs for using mobile phone applications and social media, such as content sharing within mobile applications (Ames and Naaman, 2007; Goh et al., 2009), playing online games (Wu et al., 2010), and social networking sites (Bumgarner, 2007; Joinson, 2008; Raacke and Bonds-Raacke, 2008). No formal study has directly investigated U&G of weather consumption, though Demuth et al. (2011) suggest it as an area of future investigation of

motivations behind weather media consumption, and others have applied the concepts of U&G to other loosely similar topics such as environmental coverage (Holbert et al., 2003). While understanding uses and gratifications of individual media platforms is important, considering the context of consumption with context to larger society may be more encompassing, especially when individuals are considering science and risk-based messages.

Media system dependency theory

MSD Theory arose as a shift away from focusing mainly on effects related to individual choice and use (see Ball-Rokeach, 1998), toward a counter-perspective of considering the inter-related role with society. Since news broadcasts (weather included) are not consumed inside a media vacuum and often include some consideration of what is going on societally or environmentally, MSD Theory seems most appropriate for this present work. Rubin and Windahl (1986) attempted to get at this combination of ideas, by including the dependency model with gratifications as an interaction with media dependency, which served to enhance media effects. Since humans can derive useful and functional goals from media consumption and use, addressing similarities between U&G and media dependency can explain why individuals may find these platforms useful and the subsequent effects arising from media usage. Individuals tend to be more dependent on media during times of dangerous weather (Hirschburg et al., 1986; Loges, 1994), such that it may heighten the level of dependency to which they normally have with media to fulfill goals (Ball-Rokeach et al., 1984) and subsequently enhance the desired outcome behavior.

The theory defines a media dependent relationship as one in "which the satisfaction of needs or the attainment of goals by individuals is contingent upon the resources of the other party" (Ball-Rokeach and DeFleur, 1976, p. 6). The framework is grounded in the assumption that as a society advances and technology becomes more complex in nature, media begin assuming more unique information functions – which were originally put forth as gathering, processing, and delivering information. Similarly, the roles in which media partake have different levels of centrality (i.e., more socially essential) in their function. These media – which serve as more central - are usually seen as more important to the audience, or media which the audience rely upon more for social and individual wellbeing. A second assumption, though arguably less important for this present line of research, also suggests that when there is a higher degree of change and conflict in society, there is a subsequent heightened media dependency for orientation and stability in society. During these states of flux or challenges to institutional norms, individuals rely on media information more. One such example of this could be a major weather event. Weather events can cause physical and social change to a location and its environment, through evacuations, damage, and/or infrastructure problems, and may serve as a flux state of uncertainty or change for an individual.

Finally, one would be remiss to not address the similarities and differences of both U&G and MSD Theory when considering the usage for design of research. U&G, as originally posited, was designed to examine the audience member viewpoint or perceptions for choosing some media to fulfill a gratification or need. This approach focuses on the audience member specifically, but often-without considering the interrelationship between user and larger society. It seems plausible that if an individual chooses to acquire information, they do so while considering other things going on in society. Since individuals use media to meet a variety of needs, there exists the possibility for users to derive a reliance on specific sources which can meet these needs in a consistent manner.

Parasocial interaction and similarity

How dependent an individual is with media may be a result of the ambiguity of a situation or environmental context (Ball-Rokeach, 1985), which related to uncertainty reduction and humans' natural drive to reduce uncertainty. Dependency has also been shown predict the prevalence of media effects (Grant et al., 1991), and specific to television news, the personality characteristic which the newscaster exhibits are often identified as elements of an interaction between newscaster and audience member (Levy, 1979; Palmgreen et al., 1980; Rubin et al., 1985). Deriving a need or dependency on media based on information acquisition leads to enhanced parasocial interaction and news realism (Rubin et al., 1985). Finally, parasocial interactions typically serve as an intermediary in the relationship between dependency and effects of media, which has been shown in examples such as television shopping purchases after having a parasocial interaction with the hosts of the shopping show (Grant et al., 1991; Skumanich and Kintsfather, 1998). The earliest work around parasocial interaction (Horton and Richard Wohl, 1956) described the process as a relationship with a television media "persona" which touches upon feelings or intimacy and/or friendship. Additionally, media "personas" have the opportunity to influence and form interactions because of their conversational style and often-relaxed presentation, and the production techniques which television studios use (closeness of the cameras, style and appearance of the talent, conversational banter amongst anchors, etc.; Horton and Richard Wohl, 1956; Nordlund, 1978; Meyrowitz, 1982; Rubin et al., 1985).

PSI serves as a potential explanation for how individuals form a bond or relationship with the meteorologist or broadcaster which presents their television weather forecasts. Since users consume media to achieve a variety of needs, some of which include social and enjoyment needs, there

exists a possibility to form some bond with a television news persona. Though understudied in an experimental fashion, several scholars discuss the possibility of parasocial interactions existing with weather personalities (Houlberg, 1984; Sherman-Morris, 2006; Sutter and Flores, 2009). The process is one which explains an illusionary experience where individuals perceive that they interact with media and the subsequent characters which are being consumed. This one-sided relationship with a media persona is a feeling of reciprocation between the individual and the mediated character or persona and can even go as far as individuals viewing the mediated persona as a true friend or a real bond. Further, if a user relies or feels dependent on some media (or individual platform) to achieve a gratification of some sort, a parasocial interaction with an individual on that medium or platform may serve to explain some of the reasoning for why individuals chose or rely on said media. Thus, if an individual utilizes or depends on media, then parasocial interaction with a weather personality should increase the effect getting viewers to retain, listen, or act on information.

One additional way individuals can feel a connection or bond with a television broadcaster is through homophily. Homophily is the process through which people feel similar to others, and thus feel more connected with these individuals (McCroskey et al., 1975). Most simply, individuals are typically attracted to others who display similar characteristics and personality (Byrne and Nelson, 1965) and elicit more trust in these similar individuals as well (Brewer, 1979). Race is one route to which individuals find another similar or dissimilar and may influence how information is received by an audience. Ethnicity is comprised of the attitude's and beliefs associated with one's own ethnic group, knowledge, and cultural background (Phinney, 1990; Sodowsky et al., 1995). There is a documented preference for individuals to seek out interaction with similar others on attributes such as sex, race, and education level (Rogers and Kincaid, 1981; Ibarra, 1992). In health communication and marketing literature, there is evidence for individuals seeking out or finding utility in messages which are targeted to be similar to the receiver's characteristics (Arpan, 1973; Deshpandé and Stayman, 1994). In risky situations and disasters, racial and ethnic groups may be less likely to believe or act on a warning message (or find it credible) without seeking out and finding confirmation through other social groups such as family and networks (Fothergill et al., 1999; Lindell and Perry, 2003; Spence et al., 2007). Even when considering poverty, or geographic location in a crisis proximity, cultural factors still play an important role in message reception during a risk (Lindell and Perry, 2003). Finally, in media – black individuals which identify strongly with their ethnic background prefer black targeted webpages when compared to those who identify in a weaker fashion (Appiah, 2004; Melican and Dixon, 2008).

Personality characteristics and the relatedness to them are another predictor for identifying with a mediated persona (Hoffner and Buchanan, 2005). It is not uncommon for individuals to situate themselves in social networks through a preference for homophily. Personality characteristics also explain the formation of interpersonal attraction and the subsequent networks which individuals interact (Lazarsfeld and Merton, 1954; McPherson and Smith-Lovin, 1987; Marsden, 1988; Ibarra, 1992). These drives toward similar interactions and networks can be explained through two perspectives, interpersonal attraction and structural perspective. Interpersonal attraction refers to our biological preferences for relationships with others, and structural perspective refers to how individuals structure their networks for interaction through availability.

The role of trust and credibility in news, weather, and science

In the conversation of impending risks, trust and credibility have been examined extensively, and this is true in meteorology as well. Individuals generally report that mistrust is one of the major reasons for not taking action on impending risks (Slovic, 1999) indicating the importance of having high trust when serving in as an influencer of a network or audience. In their review of the concept of trust, Rousseau et al. (1998) find that the definition crosses various domains and fields. One commonality often found in the defining factors of trust is the idea of being or willing to be vulnerable (Malhotra, 2004).

Local news stations offer an access point for those seeking information about risks, due to their high penetration and rate of use, especially since access and preference are important during risk events (Lindell and Perry, 2012). The importance of trust is no different for warning forecasts either (Morss and Hayden, 2010), likely attributed to higher false rates and what can be seen as crying wolf when forecasts are considered false warnings or false alarms (Dow and Cutter, 1998; LeClerc and Joslyn, 2015). Unfortunately, what constitutes trust is dependent on what the user expects to occur – and this can be confounded by misinterpretation or poor delivery of a message (Siegrist et al., 2005). Finally, individuals may have more trust in one source over, likely emerging from confidence in that organization, which may influence their interpretation of risk (Lazo et al., 2009).

Organizational trust has been shown to be important toward perceptions of response agencies, officials in the government, or other organizations which disseminate information or resources during risks or crises (Spence et al., 2013b). Source choice depends on the perceived trust and credibility a user has in the organization (Renn and Levine, 1991; Slovic, 1993; Siegrist et al., 2005). Local news stations often tend to be most trusted due to their ability to deliver localized information in a relatively timely manner – much of which is delivered from the broadcast meteorologist (Sherman-Morris, 2005; Olmstead et al., 2011).

Research in this domain also generally lends support for the response to crises may not only influence the situation or scenario at present, but also may influence larger opinions and perceptions of an organization as a whole (Spence et al., 2013a).

Credibility – in the simplest terms – is an individual's level of believability (McCroskey and Young, 1981). Credibility has been explicated across numerous fields, and slight variations in definition lead to the inclusion of various factors that researchers have considered when examining credibility. For example, factors such as expertness and trustworthiness (Hovland et al., 1953), safety, qualification, and dynamism (Berlo et al., 1969), and competence, goodwill, and trustworthiness (Teven and McCroskey, 1997) have all been argued to be included in credibility judgements.

Specific to competence, an individual's sex also influences whether they are perceived as credible. Generally, research suggests males perceived as holding higher levels of credibility when compared with females, though this can vary in differing fields. For example, when working in small groups on tasks, men can be perceived to be more competent than women (Wood and Karten, 1986). Older men can be viewed as more intellectually competent than women (Canetto et al., 1995), and Conway and Vartanian (2000) displayed in their three studies that men are perceived to be more competent than women. In news, those newscasters which are fluent, pleasant, and clear, are often rated higher in competence and composure (Burgoon, 1978).

Among college students though, Werner and LaRussa (1985) found that participants found women to have higher trustworthiness than men. Specific to news, research has found that older newscasters are perceived to be more credible, in particular older men (Weibel et al., 2008); white newscasters have been rated in a more positive manner for extroversion, cheerfulness, and qualification (Balon et al., 1978); and Burgoon (1978) found that those with slower vocalizations were rated more competent and composed while being rated as less likely to influence judgements of character, sociability, and extroversion. Finally, individuals rated higher in physical attractiveness can be seen as being higher in liking toward that individual and having expertise and trustworthiness than a lower-rated attractiveness individual.

Because of their unique skillset with respect to the remainder of a newsroom, meteorologists often take on science reporting roles beyond just forecasting the weather (Wilson, 2002, 2008). Aside from a health reporter, meteorologists may be the only physical science-degreed person working for a news organization, which often makes them the go-to for science information (Henson, 2013). Couple this with the fact that scientists as a community are one of the most trusted (Scheufele, 2013; Jamieson and Hardy, 2014), there exists an idea that being a degreed meteorologist may also influence perceptions of one's forecast. Weathercasts can often expand beyond the traditional bounds of providing the forecast or focusing solely on atmospheric science. When events – such as earthquakes, an eclipse, or even public health related events occur, meteorologists serve as a scientist which can lend some knowledge onto a situation in addition to appeasing viewer desires. Research suggests some level of informal education occurs, with science education being supported in geography topics (Earl and Pasternack, 1991), public health (Joinson, 2008), risk from large-scale disasters (Demuth et al., 2012), and more recently, in climate change education initiatives (Placky et al., 2016). Based on this aforementioned literature, the following research questions are proposed:

H1: Forecaster sex and race will affect the relationship on forecaster trustworthiness, such that those viewing the white, male forecaster will report higher trustworthiness.

H2a-e: Forecaster sex and race will affect the relationship on the five factors of forecaster credibility: competence (a), character (b), sociability (c), composure (d), and extroversion (e), such that viewing the white, male forecaster will report higher forecaster credibility values.

H3: Forecaster sex and race will affect the relationship on message credibility, such that those viewing the white, male forecaster will report higher message credibility.

RQ1: How will forecaster sex and race affect information retention?

Methods

For this project, two separate experiments were conducted to examine the proposed hypotheses. The experiments were conducted independently of each other (results from the first experiment did not inform the second experiment/collection), and the second study was essentially a replication utilizing a different sample.

Design

The design of both experiments is a 2 × 2 factorial design. Two manipulations are made across the four videos: manipulation one is in the race of the forecaster (black/white) and manipulation two is the biological sex of forecaster (Male vs. Female). The purpose of the manipulation is to examine potential sex and race effects among two different samples, using the four stimuli developed for this project.

Stimuli and manipulation

The stimuli were presented in the form of YouTube videos, which would be reasonably presented on a newscast. Weather events serve useful for investigation because nearly all humans

are impacted by the weather, and diverse groups may have especially strong opinions about the weather due to past distrust with warning and recovery agencies and being affected by disasters disproportionately (Melillo et al., 2014).

The mock weather hit lasted from 1:05 to 1:20 in duration dependent on the forecaster (this does deviate somewhat from a standard broadcast weather hit of 3 min but runs akin to what an individual may encounter on the web or social media, or in a shorter context weather hit). The weather hit only referenced populated or well-known geographic locations, in hopes of representing the entire United States helping to give the mock forecast a feeling of relevance for the participants.

Experiment one sample and procedure

Given a minimal anticipated effect size of approximately 0.15 at a probability level of 0.05 and with power of 0.8, it can be anticipated that 85 students will be needed per condition. Approximately 500 students were drawn from an undergraduate participant pool during Spring 2019, at a large northeastern public university – following standard protocol procedures for utilizing the participant pool. The final usable sample for experiment one was $N = 481$, after removing participants who failed the manipulation check of recalling the broadcaster's race and sex.

Students were invited to participate in the online experiment, through an IRB-approved information sheet and were credited with a pre-determined portion of course credit for their participation. Once eligibility was screened (18 years or older), students were asked to confirm their intent to participate and were directed to the online survey portion of the experiment. Any student who was ineligible to participate was given an alternative assignment of equal length. Pre-test measures were asked immediately prior to the stimuli delivery, to not prime participants on the purpose of reporting these variables. Participants were then be randomly assigned to one of the four experimental conditions in the form of a YouTube video resembling a broadcast weather forecast (described in detail below). After watching the approximately one-minute video, participants returned to the survey portion of the process, and answered post-test and demographic questions. Upon completion, participants were thanked for their time, and re-directed to another external Qualtrics survey for inputting information to receive course credit.

Experiment two sample and procedure

Sampling for experiment two utilized Amazon's Mechanical Turk (MTurk; www.mturk.com) participant program during April 2019. Following a similar Power Analysis as Experiment 1 approximately 600 participants were necessary to be drawn. The final usable sample for this experiment was $N = 595$ after removing participants who failed the manipulation check of recalling the broadcaster's race and sex. Upon completion of the survey, participants were credited with $0.50 which was based on time requirements to complete the experiment.

The overall procedure followed akin to Experiment 1. Participants were invited to participate in the online experiment, through an IRB-approved information sheet which was hosted on the online-survey platform Qualtrics. Once eligibility was screened (18 years or older, never previously taken the survey, U.S. resident), participants were asked to confirm their consent and be directed to the online survey portion of the experiment.

Measures

Independent variables

The two independent variables of interest for both experiments are the manipulations made in the stimuli videos. Since one of the main goals of this project is to probe the effects of two or more independent variables simultaneously, effect coding ranging from −1 to 1 (contrast coding) is utilized. Effect coding allows for the comparison of two or more groups, with some reference group to examine differences.

Meteorologist biological sex

Biological sex was measured as an independent variable based on which manipulation a participant was exposed. Participants viewed a mock weather hit which had a forecaster with the appearance of either a male or female, and these were subsequently coded as follows: female = −1, male = 1.

Meteorologist race

Race was also measured as an independent variable based on which manipulation a participant was exposed. Participants viewed a mock weather hit which had a forecaster who appears either black or white, and the coding scheme was black = −1, white = 1.

Experiment 1 – Dependent variables

Forecaster credibility

Two separate concepts of credibility were measured (forecaster credibility and content credibility) which each target a different perspective of credibility (individual vs. message). Credibility of the forecaster was measured utilizing the newscaster credibility scale (McCroskey and Jenson, 1975). The scale is a five-dimension, 25-item scale of 7-point semantic differential phrases, which examine individuals' perceptions of competence, character, sociability, composure, and extroversion of a newscaster. Upon completing a CFA, the five factors did emerge as expected [χ^2 (220) = 918.46; $p < 0.001$, CFI =

0.92, RMSEA = 0.08]. Two items in the extroversion factor were dropped due to poor loadings, leaving a 23-item scale to measure the five factors. The five factors were each averaged into respective individual variables and renamed as follows: (forecaster) *competence* ($M = 5.37$, $SD = 0.90$, $\alpha = 0.93$); *character* ($M = 5.13$, $SD = 98$, $\alpha = 0.88$); *sociability* ($M = 5.62$, $SD = 1.02$, $\alpha = 0.93$); *composure* ($M = 5.41$, $SD = 1.06$, $\alpha = 0.83$); and *extroversion* ($M = 5.32$, $SD = 1.06$, $\alpha = 0.88$).

Content credibility

The second credibility dimension accounts for the credibility of the message content (i.e., the forecast). Message credibility is measured to assess the credibility of the actual message rather than the credibility associated with the message source. Message credibility was measured using a slightly adapted version of Appelman and Sundar (2016) message credibility scale. This scale is a 3-item Likert-type scale which asks participants "How well do the following adjectives describe the content you just read?" with responses ranging from 1 (describes very poorly) to 7 (describes very well) on the adjectives *accurate*, *authentic*, and *believable*. The question was slightly adjusted to read "How well do the following adjectives describe the content you just watched" since participants will be viewing the forecast as a video rather than reading it. The items were averaged into a message credibility variable ($M = 5.41$, $SD = 0.97$, $\alpha = 0.90$) with no items dropped.

Forecaster trustworthiness

To measure trustworthiness of the forecaster, one dimension of McCroskey and Teven's (1999) source credibility scale was utilized. Source credibility is typically a three-factor construct, consisting of trustworthiness, competence, and goodwill of a source. Each construct is measured with six semantic differential type items, which have two antonyms on 7-point scales, and typically subject to a CFA to ensure a three-factor solution. The six semantic differential antonyms were prompted by the question "please indicate your feelings about the meteorologist you just viewed." With respect to participant fatigue and because individuals are rating credibility through other measures, only the trustworthiness factor was measured. Forecaster trustworthiness was subject to a CFA, $\chi^2(6) = 24.3$; $p < 0.001$, CFI = 0.99, RMSEA = 0.08, and no items were deleted when averaging into a singular variable ($M = 5.24$, $SD = 0.87$, $\alpha = 0.89$).

Information retention

Five true or false items were asked based off factual information presented in the stimuli. Timing of the retention questions was considered, such that attempts were made for the answers to the retention questions to occur approximately every 10 s in the video. All 5-items were summed into a composite retention variable and treated as an outcome ($M = 3.36$, $SD = 1.24$, no alpha). 21% of the sample were able to score five correct answers for the retention variable, and 26% of the sample scored four questions correct.

Experiment 2 – Dependent variables

Forecaster and content credibility

Two separate factions of credibility were measured (forecaster credibility and content credibility) which each target a different level of credibility (individual vs. content). Credibility of the forecaster was measured following the newscaster credibility scale (McCroskey and Jenson, 1975). The scale is a five-dimension, 25-item scale of 7-point semantic differential phrases, which examine individuals' perceptions of competence, character, sociability, composure. The scale underwent a CFA, for which a five-factor solution emerged after dropping six total items [$\chi^2(142) = 490.62$; $p = 0.000$, CFI = 0.96, RMSEA = 0.06]. The five factors (to be treated as individual respective variables) which emerged are *forecaster competence* (six items; $M = 5.29$, $SD = 1.34$, $\alpha = 0.93$), *character* (4 items; $M = 5.38$, $SD = 1.07$, $\alpha = 0.78$), *sociability* (four items, $M = 5.42$, $SD = 1.44$, $\alpha = 0.94$), *composure* (two items; $M = 5.31$, $SD = 1.43$, $\alpha = 0.78$), and *extroversion* (three items; $M = 4.67$, $SD = 1.49$, $\alpha = 0.85$).

The second credibility dimension accounts for the credibility of the message content (i.e., the forecast). Message credibility was measured to assess the credibility of the actual message rather than the credibility associated with the message source. Message credibility was measured using a slightly adapted version of Appelman and Sundar (2016) message credibility scale. This scale is a 3-item Likert-type scale which asks participants "How well do the following adjectives describe the content you just read?" with responses ranging from 1 (describes very poorly) to 7 (describes very well) on the adjectives *accurate*, *authentic*, and *believable*. The question was slightly edited for specificity, to read "How well do the following adjectives describe the content you just watched" since participants will be viewing the forecast as a video rather than reading it. The final content credibility variable was computed by averaging the three item responses ($M = 5.71$, $SD = 0.93$, $\alpha = 0.85$).

Forecaster trustworthiness

To measure trustworthiness of the forecaster, one dimension of McCroskey and Teven's (1999) source credibility scale was measured. Source credibility is typically a three-factor construct, consisting of trustworthiness, competence, and goodwill of a source. Each construct is measured with six semantic differential type items, which have two antonyms

on 7-point scales, and typically subject to a CFA to ensure a three-factor solution. With respect to participant fatigue and because individuals are rating source credibility through a separate measure, only trustworthiness was measured as a singular factor which is treated as composite individual forecaster trust variable. This variable was measured with six 7-point semantic differential antonyms prompted by the question "please indicate your feelings about the meteorologist you just viewed." After removing three poor-loading items, the remaining CFA model was just-identified.

Information retention

Five true or false items were asked based off factual information presented in the stimuli. The goal here was to space out the answers to the retention questions at approximately every 10 seconds in the video. All 5-items were summed into a composite retention score and treated as an outcome variable ($M = 2.34$, $SD = 1.5$). 24% of the participants scored 4 or 5 correct answers, while approximately 57% retained 0, 1, or 2 correct answers.

Results

Prior to coding and analyzing the data, various researcher judgements were made while data cleaning. First, all surveys designated as *in-progress* by Qualtrics were deleted (all reported finishing 50% or less of the survey) as to ensure a respondent completed the requirements of the survey. Second, any surveys which were completed in an unrealistic amount of time (under 300 s) were also deleted, and seven cases were removed from the sample for failing the manipulation check. This resulted in a final usable sample of $N = 481$.

Descriptive statistics and sample characteristics

After data cleaning, breakdown for the descriptive variables were exampled. Regarding the sex of the sample, a majority (51.6%) of the sample was female. The mean age was 19.3 years old. Approximately 69% of the sample was white, 7% black, 6% Latino or Latin American, 12% Asian-American, and 5% of participants specifying another racial demographic. The sample had a slight liberal skew, with 45% reporting a liberal political belief, and more than a quarter (26.4%) reporting they consider themselves neither conservative nor liberal. 89% of the sample reported residing in New England primarily, and the average media use was approximately 7 h per day ($SD = 3.43$), with a range from 0 to 18 h daily.

All variables of interest were examined for their relationships with another (through correlations), normality, and any possible skew. No variables had more than a slight skew which could be explained through a ceiling effect. All variables followed patterns of normality as well. Finally, comparisons across experimental conditions are made in the following analysis, as equal randomization was successful – and all groups have roughly equal cell sizes for comparing results. For experiment one, two separate types of analyses will be performed to address the hypotheses and research questions.

Analyzing mean differences

In order to examine the hypotheses and research question under consideration, a set of bivariate correlations was first performed across the dependent variables in both data sets; results indicated that all dependent variables were significantly correlated in both samples (all $r > 0.16$). Given this finding, the hypotheses and research question were examined using a 2 × 2 MANOVA, crossing forecaster race (White/Black) by forecaster sex (male/female). Omnibus tests are reported, followed by univariate tests where applicable.

Multivariate tests for experiment one revealed main effects for both sex, $F_{(8,438)} = 2.08$, $p < 0.04$, Wilks' $\lambda = 0.963$, and race, $F_{(8,438)} = 4.69$, $p < 0.001$, Wilks' $\lambda = 0.921$. They failed to reveal an interaction effect between the two, $F_{(16,1144)} = 0.74$, *n.s.* Main effects of sex were detected on competence, $F_{(1,445)} = 6.40$, $p < 0.01$, $\eta^2 = 0.02$, sociability, $F_{(1,445)} = 7.82$, $p < 0.01$, $\eta^2 = 0.02$, composure, $F_{(1,445)} = 6.07$, $p < 0.02$, $\eta^2 = 0.02$, and extroversion, $F_{(1,445)} = 8.38$, $p < 0.003$, $\eta^2 = 0.02$. The pattern of means indicates that male respondents gave slightly higher ratings on competence, composure, and extroversion, while females gave slightly higher scores on sociability (see Table 1).

For forecaster race, univariate tests indicated a main effect on retention, $F_{(1,445)} = 29.76$, $p < 0.001$, $\eta^2 = 0.04$, competence, $F_{(1,445)} = 10.33$, $p < 0.001$, $\eta^2 = 0.03$, sociability, $F_{(1,445)} = 13.15$, $p < 0.001$, $\eta^2 = 0.03$, composure, $F_{(1,445)} = 10.18$, $p < 0.002$, $\eta^2 = 0.02$, credibility, $F_{(1,445)} = 6.65$, $p < 0.002$, $\eta^2 = 0.02$, and trust $F_{(1,445)} = 5.65$, $p < 0.005$, $\eta^2 = 0.02$. The pattern of means suggests that White respondents gave higher scores to these outcomes than did Non-White respondents (see Table 2).

For experiment two, omnibus tests failed to indicate main effects for sex, $F_{(16,1144)} = 1.61$, *n.s.*, nor race $F_{(8,572)} = 0.99$, *n.s.* They also failed to reveal an interaction effect between the two, $F_{(16,1144)} = 0.74$, *n.s.*

Discussion

The findings both experiments suggest that there is a desire for a "competent" forecaster to deliver the forecast. A factor

TABLE 1 Experiment 1 – group statistics.

	Sex condition	*N*	Mean	Std. deviation	Std. error mean
Competence	Female	243	5.3333	0.87537	0.05615
	Male	238	5.3983	0.93044	0.06031
Sociability	Female	243	5.6982	0.98522	0.06320
	Male	237	5.5362	1.04343	0.06778
Composure	Female	243	5.3213	1.08489	0.06960
	Male	238	5.5053	1.02512	0.06645
Extroversion	Female	243	5.2826	0.99479	0.06382
	Male	238	5.3487	1.01061	0.06551

TABLE 2 Experiment 1 – group statistics.

	Race	*N*	Mean	Std. deviation	Std. error mean
Retention	Non-White	134	2.9627	1.13327	0.09790
	White	325	3.5292	1.24098	0.06884
Competence	Non-White	145	5.1440	0.93789	0.07789
	White	334	5.4616	0.87332	0.04779
Sociability	Non-White	144	5.3524	1.10566	0.09214
	White	334	5.7313	0.95793	0.05242
Composure	Non-White	145	5.1914	1.12269	0.09323
	White	334	5.5077	1.01907	0.05576
Credibility	Non-White	142	5.1854	1.05970	0.08893
	White	328	5.5112	0.90748	0.05011
Trustworthiness	Non-White	145	5.0736	0.89103	0.07400
	White	334	5.3149	0.84752	0.04637

such as sociability may not actually be necessary in delivering the forecast, though one may argue that this personality characteristic manifests itself in a variety of delivery methods, vocal patterns, and how a meteorologist chooses to interact with their audience.

In experiment one, there was a general attempt to establish baseline knowledge about how a forecasters sex or race may influence trust, credibility, or retaining information from the forecast. Using a convenience sample is a good starting point for understanding these patterns, to then further investigate and probe them in experiment two. For hypothesis one, it is interesting to note that the effect sizes for the race and sex main effects are similar in magnitude to those found when studying mass media (under 0.10). Sex played a more significant role in influencing trustworthiness of the forecaster, whereas race did not play a significant role in influencing perceived trust.

An interesting future area of research would be to understand how in-group and out-group participants rated these individuals, to see if those who viewed another as part of their in-group rated the forecaster higher in trust than those who saw a forecaster as someone who was out-group. This could potentially be done through some type of race-match (or group-match) variable but doing so would also reduce the cell sizes for analysis because of the majority of participants being white (69%) and the roughly 50% chance someone could be assigned to either race condition.

Because there was no pre-testing done on the stimuli prior to investigating them, some findings could be a byproduct of subtle differences in how the forecaster may have presented themselves and the information in the video. In other words, there may be subtle differences in experience, delivery, tone, pace, so on and so forth, that were not controlled for during the design phase that could be influencing this result, though directions were given to forecasters (through manipulating the presentation of what to display on screen and how to talk about it) in hopes of keeping similarities across the conditions. Furthermore, all four individuals who served as the individuals in the stimuli are professional broadcast meteorologists for a relatively well-known weather organization, such that there should not be a large variance between quality in delivery/performance.

One possible explanation in the inconsistency of findings across the two experiments could actually lend support for media dependency theory. Though media dependency was used

as an explanatory framework for this study rather than a predictive model, the underlying tenants of media dependency appear to be extremely important to consider here. As presented in the literature, media dependency theory suggests that media and audience members must be studied in the larger context of society and the interaction with other systems. This seems particularly relevant here, as individuals participating in the study are bringing their own societal beliefs, views, and attitudes toward a particular race, sex, and to some degree even scientists at large to the table when considering the forecast to which they were exposed. It stands reasonable that there are additional variables which may explain some of these relationships that were not captured in this study (religious views, belief in science, prior experiences with media as a few examples). Since the manipulations made across both experiments (race and sex) were based on demographic differences, it made sense to collect and utilize participant demographics are control variables and for an initial understanding. Yet moving forward, it may make sense to include more nuanced variables which get at attitudes and values and individual may hold and bring to the table when considering a broadcaster.

In sum, this project attempts to explore under-investigated areas in the fields of communication, media, meteorology, and science. First and foremost, understanding if any implied biases, stereotypes, cognitive judgements, heuristics, or the like - which may be tied to an individual's appearance – influence outcome perceptions of that forecaster, scientist, anchor, or meteorologist is extremely important to knowing how messages are received. This study makes an initial attempt at understanding patterns of how individuals receive a forecast, and then make subsequent judgements on the forecaster delivering the message or the actual content of the message itself. The goal here is that these two experiments can help to promote and guide a line of research in this domain which allows practitioners, forecasters, and broadcast executives to understand the downstream effects related to an individual's appearance on camera.

Second, this study combines two areas of communication and media - mass communication/media and science communication – to further this growing body of work which looks at how mass media can influence subsequent representations of science and technical information. In the field of broadcasting, and more specifically broadcast meteorology, there is a limited understanding of how television meteorologists or broadcasters serving as meteorologists are perceived based off their appearance, demographic factors, or if individuals even care that their local meteorologist has a physical science degree. It's very easy for an individual to anecdotally point to a person's attire or their appearance and suggest that attractiveness or appearance may dominate why an individual is believed or trusted. Yet, research in this domain that applies specifically to television broadcasters has limited knowledge of what important factors that could influence these outcomes of trust, believability, credibility, or even retaining information, having mainly been focused on news anchors or vocal representations of delivery. It becomes more important to gain knowledge in this area, knowing full well that those factors of trust and credibility are some of the most influential to getting audience members and individuals to act upon weather information. Additionally, better understanding how these influences work in differing contexts, for example during a hurricane warning compared to a sunny day, may be important. First, the findings from both experiments are presented and discussed, before expanding upon future directions to pursue in this line of research.

Though attempts were made to limit the possible influences which could disrupt an experiment and muddy the results, there are a few limitations which may also explain some of the findings. First, the experimental conditions were not pre-tested due to time constraints and the difficulty of finding enough diverse individuals to reasonably pretest differences across videos. A future work may attempt to pre-test some of the experimental conditions, to ensure other confounds that are left unaddressed may not influence the results. For example, making attempts to equalize delivery patterns, rates of speed, or tone in speaking may help address differences that could arise due to a person's vocalizations rather than appearances. Attempts were made to normalize the conditions to a reasonable degree by providing the broadcasters with rough scripts for which they could work off. Since meteorologists do not work off a script – different than a news anchor – it does not make sense to force them into a rigid pattern of speech through a scripted package, rather than give the broadcaster some flexibility in ad-libbing the content while ensuring that certain markers are consistent across the forecasts. Similarly, this consistency across the conditions allows for measuring the retention variable.

Additionally, there is the experimental give and take with bringing participants into a laboratory for additional experimental control versus allowing them to watch a video in a normal setting – as one would expect to consume a weather forecast on a daily basis. Thus, there is the possibility that participants were doing other things in lieu of watching the video, though attempts were made to keep them relatively brief in hopes that participants would pay due attention. Furthermore, neither sample comes without limitations. The goal of utilizing a student convenience sample was to develop a general understanding of how some of these relationships may play out amongst an easily accessible population. Then, one can take this and apply it to a more representative sample in something like MTurk (though this comes with caveats as well). A future investigation might seek to sample from different geographic regions across the United States, since there are differences in both weather patterns and differences amongst the demographics of meteorologists which appear on air varying by region.

The field of meteorology and weather forecasts in general are a ripe area of investigation for understanding more about these

relationships, because weather has the ability to influence so many of society's larger systems (e.g., a snow day influencing the economy). Furthermore, there has been a shift to more diverse and fragmented choices for consuming weather – down to the point of not even needing a human to forecast or communicate the information to a user directly. Most mobile phones come with weather applications preinstalled, many individuals are cutting some of their cable packages which are traditional forms of weather consumption, and the legacy method of talking interpersonally to an individual still exists. Thus, this is a very fragmented domain where users now actively select from a variety of choices – and could reasonably have the ability to avoid messages (or people/channels/etc.) they choose to not view. The work here attempts to extend upon the very limited research in this domain (particularly Weibel et al., 2008; Brann and Himes, 2010), and future work in this domain would strengthen the fields of broadcast meteorology, broadcast news, and risk communication well – in the hopes that individuals don't engage in biased processing when intaking important information about the weather forecast.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving human participants were reviewed and approved by the University of Connecticut IRB. The patients/participants provided their written informed consent to participate in this study.

Author contributions

AR and KL contributed to the design and conception of the study. AR collected the data. KL analyzed data. Both authors contributed to the article and approved the submitted version.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fcomm.2022.1052277/full#supplementary-material

References

Ames, M., and Naaman, M. (2007). "Why we tag: motivations for annotation in mobile and online media," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. New York, NY: ACM, 971–980.

Appelman, A., and Sundar, S. S. (2016). Measuring message credibility: construction and validation of an exclusive scale. *J. Mass Commun. Q.* 93, 59–79. doi: 10.1177/1077699015606057

Appiah, O. (2004). Effects of ethnic identification on web browsers' attitudes toward and navigational patterns on racetargeted sites. *Commun. Res.* 31, 312–337.

Arpan, L. M. (1973). (2002). When in Rome? The effects of spokesperson ethnicity on audience evaluation of crisis communication. *J. Bus. Commun.* 39, 314–339. doi: 10.1177/002194360203900302

Avolio, B., Chávez, J., and Vílchez-Román, C. (2020). Factors that contribute to the underrepresentation of women in science careers worldwide: A literature review. *Soc. Psychol. Educ.* 23, 773–794.

Ball-Rokeach, S. J. (1985). The origins of individual media-system dependency: a sociological framework. *Commun. Res.* 12, 485–510. doi: 10.1177/009365085012004003

Ball-Rokeach, S. J. (1998). A theory of media power and a theory of media use: different stories, questions, and ways of thinking. *Mass Commun. Soc.* 1, 5–40. doi: 10.1080/15205436.1998.9676398

Ball-Rokeach, S. J., and DeFleur, M. L. (1976). A dependency model of mass-media effects. *Commun. Res.* 3, 3–21. doi: 10.1177/009365027600300101

Ball-Rokeach, S. J., Rokeach, M., and Grube, J. W. (1984). *The Great American Values Test: Influencing Behavior and Belief Through Television*. New York, NY: Free Press.

Balon, R. E., Philport, J. C., and Beadle, C. F. (1978). How sex and race affect perceptions of newscasters. *J. Q.* 55, 160–164. doi: 10.1177/107769907805500125

Berlo, D. K., Lemert, J. B., and Mertz, R. J. (1969). Dimensions for evaluating the acceptability of message sources. *Pub. Opin. Q.* 33, 563–576. doi: 10.1086/267745

Brann, M., and Himes, K. L. (2010). Perceived credibility of male versus female television newscasters. *Commun. Res. Rep.* 27, 243–252. doi: 10.1080/08824091003737869

Brewer, M. B. (1979). In-group bias in the minimal intergroup situation: a cognitive-motivational analysis. *Psychol. Bullet.* 86, 307. doi: 10.1037/0033-2909.86.2.307

Bumgarner, B. A. (2007). You have been poked: exploring the uses and gratifications of Facebook among emerging adults. *First Monday*. 12, 11–5. https://journals.uic.edu/ojs/index.php/fm/article/download/2026/1897

Burgoon, J. K. (1978). A communication model of personal space violations: explication and an initial test. *Hum. Commun. Res.* 4, 129–142. doi: 10.1111/j.1468-2958.1978.tb00603.x

Byrne, D., and Nelson, D. (1965). The effect of topic importance and attitude similarity-dissimilarity on attraction in a multistranger design. *Psycho. Sci.* 3, 449–450. doi: 10.3758/BF03343226

Canetto, S. S., Kaminski, P. L., and Felicio, D. M. (1995). Typical and optimal aging in women and men: is there a double standard? *Int. J. Aging Hum. Dev.* 40, 187–207. doi: 10.2190/RX0U-T56B-1G0F-266U

Claisse, G., and Rowe, F. (1987). The telephone in question: questions on communication. *Comput. Net. ISDN Syst.* 14, 207–219. doi: 10.1016/0169-7552(87)90056-0

Collins, A. (2018). *The Global Risks Report 2018*. Geneva: World Economic Forum.

Conway, M., and Vartanian, L. R. (2000). A status account of gender stereotypes: beyond communality and agency. *Sex Roles* 43, 181–199. doi: 10.1023/A:1007076813819

Cranford, A. (2018). Women Weathercasters: their positions, education, and presence in local TV. *Bullet. Am. Meteorol. Soc.* 99, 281–288. doi: 10.1175/BAMS-D-16-0317.1

Demuth, J. L., Lazo, J. K., and Morss, R. E. (2011). Exploring variations in people's sources, uses, and perceptions of weather forecasts. *Weather Clim. Soc.* 3, 177–192. doi: 10.1175/2011WCAS1061.1

Demuth, J. L., Morss, R. E., Morrow, B. H., and Lazo, J. K. (2012). Creation and communication of hurricane risk information. *Bullet. Am. Meteorol. Soc.* 93, 1133–1145. doi: 10.1175/BAMS-D-11-00150.1

Deshpandé, R., and Stayman, D. M. (1994). A tale of two cities: distinctiveness theory and advertising effectiveness. *J. Market. Res.* 57–64. doi: 10.1177/002224379403100105

Desmond, R., and Danilewicz, A. (2010). Women are on, but not in, the news: Gender roles in local television news. *Sex Roles* 62, 822–829.

Dimmick, J. W., Sikand, J., and Patterson, S. J. (1994). The gratifications of the household telephone: sociability, instrumentality, and reassurance. *Commun. Res.* 21, 643–663. doi: 10.1177/009365094021005005

Dow, K., and Cutter, S. (1998). Crying wolf: repeat responses to hurricane evacuation orders. *Coastal Manage.* 26, 237–252. doi: 10.1080/08920759809362356

Earl, R. A., and Pasternack, S. (1991). Television weathercasts and their role in geographic education. *J. Geograph.* 90, 113–117. doi: 10.1080/00221349108979249

Ferguson, D. A., Greer, C. F., and Reardon, M. E. (2007). Uses and gratifications of MP3 players by college students: are iPods more popular than radio? *J. Radio Stu.* 14, 102–121. doi: 10.1080/10955040701583197

Flicker, E. (2003). Between brains and breasts—Women scientists in fiction film: On the marginalization and sexualization of scientific competence. *Pub. Understanding Sci.* 12, 307–318. doi: 10.1177/0963662503123009

Fothergill, A., Maestas, E. G., and Darlington, J. D. (1999). Race, ethnicity and disasters in the United States: a review of the literature. *Disasters* 23, 156–173. doi: 10.1111/1467-7717.00111

Goh, D. H. L., Ang, R. P., Chua, A. Y., and Lee, C. S. (2009). "Why we share: a study of motivations for mobile media sharing," in *International Conference on Active Media Technology*. Berlin: Springer, 195–206.

Gonzales, L. (2010). Participation of women in geoscience occupations. *Geosci. Curr.* 33, 1–11.

Grant, A. E., Guthrie, K. K., and Ball-Rokeach, S. J. (1991). Television shopping: a media system dependency perspective. *Commun. Res.* 18, 773–798. doi: 10.1177/009365091018006004

Green, T. A., Schreck, C. J., Johnson, N. S., and Heath, S. S. (2019). Education backgrounds of TV weathercasters. *Bull. Amer. Meteor. Soc.* 100, 581–588.

Haridakis, P., and Hanson, G. (2009). Social interaction and co-viewing with YouTube: blending mass communication reception and social connection. *J. Broadcast. Elect. Media* 53, 317–335. doi: 10.1080/08838150902908270

Henson, R. (2013). *Weather on the Air: A History of Broadcast Meteorology*. Berlin: Springer Science and Business Media.

Hirschburg, P. L., Dillman, D. A., and Ball-Rokeach, S. J. (1986). Media system dependency theory: responses to the eruption of Mount St. Helens. *Media Aud. Soc. Struct.* 2, 117–126.

Hoffner, C., and Buchanan, M. (2005). Young adults' wishful identification with television characters: the role of perceived similarity and character attributes. *Media Psychol.* 7, 325–351. doi: 10.1207/S1532785XMEP0704_2

Holbert, R. L., Kwak, N., and Shah, D. V. (2003). Environmental concern, patterns of television viewing, and pro-environmental behaviors: integrating models of media consumption and effects. *J. Broadcast. Elect. Media* 47, 177–196. doi: 10.1207/s15506878jobem4702_2

Horton, D., and Richard Wohl, R. (1956). Mass communication and para-social interaction: observations on intimacy at a distance. *Psychiatry* 19, 215–229. doi: 10.1080/00332747.1956.11023049

Houlberg, R. (1984). Local television news audience and the para-social interaction. *J. Broadcast. Elect. Media* 28, 423–429. doi: 10.1080/08838158409386551

Hovland, C. E., Janis, I. L., and Harold, H., Kelley (1953). *Communication and Persuasion.* New Haven, CT: Yale University Press.

Ibarra, H. (1992). Homophily and differential returns: sex differences in network structure and access in an advertising firm. *Admin. Sci. Q.* 1, 422–447. doi: 10.2307/2393451

Jamieson, K. H., and Hardy, B. W. (2014). Leveraging scientific credibility about Arctic sea ice trends in a polarized political environment. *Proc. Nat. Acad. Sci.* 111(Supplement_4), 13598–13605. doi: 10.1073/pnas.1320868111

Joinson, A. N. (2008). "Looking at, looking up or keeping up with people?: motives and use of facebook," in *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*. New York, NY: ACM, 1027–1036.

Kalhoefer, K. (2018). How broadcast TV networks covered climate change in 2017. Available online at: https://www.mediamatters.org/research/2018/02/12/how-broadcast-tv-networks-covered-climate-change-2017/219277 (accessed October 23, 2018).

Katz, E., Blumler, J. G., and Gurevitch, M. (1973). Uses and gratifications research. *Pub. Opin. Q.* 37, 509–523. doi: 10.1086/268109

Kaye, B. K. (1998). Uses and gratifications of the world wide web: from couch potato to web potato. *Atl. J. Commun.* 6, 21–40. doi: 10.1080/15456879809367333

Ko, H. (2000). "Internet uses and gratifications: understanding motivations for using the Internet," in *Paper presented at the 83rd Annual Meeting of the Association for Education in Journalism and Mass Communication, Phoenix, AZ.*

Ko, H., Cho, C. H., and Roberts, M. S. (2005). Internet uses and gratifications: a structural equation model of interactive advertising. *J. Adv.* 34, 57–70. doi: 10.1080/00913367.2005.10639191

Lachlan, K. A., Spence, P. R., Edwards, A., Reno, K. M., and Edwards, C. (2014). If you are quick enough, I will think about it: Information speed and trust in public health organizations. *Comput. Hum. Behav.* 33, 377–380. doi: 10.1016/j.chb.2013.08.014

LaRose, R., and Eastin, M. S. (2004). A social cognitive theory of Internet uses and gratifications: toward a new model of media attendance. *J. Broadcast. Electr. Media* 48, 358–377. doi: 10.1207/s15506878jobem4803_2

LaRose, R., Mastro, D., and Eastin, M. S. (2001). Understanding internet usage: a social-cognitive approach to uses and gratifications. *Soc. Sci. Comput. Rev.* 19, 395–413. doi: 10.1177/089443930101900401

Lazarsfeld, P. F., and Merton, R. K. (1954). Friendship as a social process: a substantive and methodological analysis. *Freedom Control Modern Soc.* 18, 18–66.

Lazo, J. K., Morss, R. E., and Demuth, J. L. (2009). 300 billion served: sources, perceptions, uses, and values of weather forecasts. *Bullet. Am. Meteorol. Soc.* 90, 785–798. doi: 10.1175/2008BAMS2604.1

LeClerc, J., and Joslyn, S. (2015). The cry wolf effect and weather-related decision making. *Risk Anal.* 35, 385–395. doi: 10.1111/risa.12336

Levy, M. R. (1979). Watching TV news as para-social interaction. *J. Broadcast. Elect. Media* 23, 69–80. doi: 10.1080/08838157909363919

Lin, C. A. (1999). Online service adoption likelihood. *J. Adv. Res.* 39, 79–89.

Lindell, M. K., and Perry, R. W. (2003). *Communicating Environmental Risk in Multiethnic Communities, Vol. 7*. Thousand Oaks, CA: Sage Publications.

Lindell, M. K., and Perry, R. W. (2012). The protective action decision model: theoretical modifications and additional evidence. *Risk Anal. Int. J.* 32, 616–632. doi: 10.1111/j.1539-6924.2011.01647.x

Liu, I. L., Cheung, C. M., and Lee, M. K. (2010). Understanding twitter usage: what drive people continue to tweet. *Pacis* 92, 928–939.

Loges, W. E. (1994). Canaries in the coal mine: perceptions of threat and media system dependency relations. *Commun. Res.* 21, 5–23. doi: 10.1177/009365094021001002

Maibach, E., Cobb, S., Leiserowitz, A., Peters, E., Schweizer, V., Mandryk, C., et al. (2011). *A National Survey of Television Meteorologists About Climate Change Education*. Fairfax, VA: George Mason University Center for Climate Change Communication.

Maibach, E., Perkins, D., Timm, K., Myers, T., Placky, B., Sublette, S., et al. (2017). *A 2017 National Survey of Broadcast Meteorologists: Initial Findings*. Fairfax, VA: George Mason University Center for Climate Change Communication.

Malhotra, N. (2004). *Investigación de Mercados*. London: Pearson Educación.

Malone, M. (2011). Women and weather jobs: the big freeze out. *Broadcast. Cable* 141, 12–14.

Marsden, P. V. (1988). Homogeneity in confiding relations. *Soc. Net.* 10, 57–76. doi: 10.1016/0378-8733(88)90010-X

McCroskey, J. C., and Jenson, T. A. (1975). Image of mass media news sources. *J. Broadcast. Elect. Media* 19, 169–180. doi: 10.1080/08838157509363777

McCroskey, J. C., Richmond, V. P., and Daly, J. A. (1975). The development of a measure of perceived homophily in interpersonal communication. *Hum. Commun. Res.* 1, 323–332. doi: 10.1111/j.1468-2958.1975.tb00281.x

McCroskey, J. C., and Teven, J. J. (1999). Goodwill: A reexamination of the construct and its measurement. *Commun. Monogr.* 66, 90–103.

McCroskey, J. C., and Young, T. J. (1981). Ethos and credibility: the construct and its measurement after three decades. *Central States Speech J.* 32, 24–34. doi: 10.1080/10510978109368075

McPherson, J. M., and Smith-Lovin, L. (1987). Homophily in voluntary organizations: Status distance and the composition of face-to-face groups. *Am. Sociol. Rev.* 1, 370–379. doi: 10.2307/2095356

Melican, D. B., and Dixon, T. L. (2008). News on the net: credibility, selective exposure, and racial prejudice. *Commun. Res.* 35, 151–168. doi: 10.1177/0093650207313157

Melillo, J. M., Richmond, T. T., and Yohe, G. (2014). Climate change impacts in the United States. *Third Nat. Clim. Assessment* 2014, 52. doi: 10.7930/J0Z31WJ2

Metzger, M. J., Flanagin, A. J., and Zwarun, L. (2003). College student Web use, perceptions of information credibility, and verification behavior. *Comput. Educ.* 41, 271–290. doi: 10.1016/S0360-1315(03)00049-6

Meyrowitz, J. (1982). "Television and interpersonal behavior: codes of perception and response," in *Inter/media: Interpersonal Communication in a Media World*, eds G. Gumpert and R. Cathcart (New York, NY: Oxford University Press), 221–241.

Mirsky, S. (2000). Channeling the weather: talking about the weather isn't so simple on TV. *Sci. Am.* 11, 104.

Morris, M., and Ogan, C. (1996). The Internet as mass medium. *J. Commun.* 46, 39–50. doi: 10.1111/j.1460-2466.1996.tb01460.x

Morss, R. E., and Hayden, M. H. (2010). Storm surge and "certain death": interviews with Texas coastal residents following Hurricane Ike. *Weather Clim. Soc.* 2, 174–189. doi: 10.1175/2010WCAS1041.1

National Academy of Sciences, National Academy of Engineering, and Institute of Medicine (2007). *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*. Washington, DC: The National Academies Press. doi: 10.17226/11741

Nordlund, J. E. (1978). Media interaction. *Commun. Res.* 5, 150–175. doi: 10.1177/009365027800500202

Olmstead, K., Mitchell, A., and Rosenstiel, T. (2011). Navigating news online: where people go, how they get there and what lures them away. *Pew Res. Center Proj. Exc. J.* 9,1–30.

Palmgreen, P., Wenner, L. A., and Rayburn, J. D. (1980). Relations between gratifications sought and obtained: a study of television news. *Commun. Res.* 7, 161–192. doi: 10.1177/009365028000700202

Papacharissi, Z., and Rubin, A. M. (2000). Predictors of internet use. *J. Broadcast. Elect. Media* 44, 175–196. doi: 10.1207/s15506878jobem4402_2

Papper, B. (2005). News staffing and profitability survey. *RTNDA Commun.* 59, 34–38.

Perryman, N., and Theiss, S. (2014). "Weather girls" on the big screen: stereotypes, sex appeal, and science. *Bullet. Am. Meteorol. Soc.* 95, 347–356. doi: 10.1175/BAMS-D-12-00079.1

Phinney, J. S. (1990). Ethnic identity in adolescents and adults: review of research. *Psychol. Bullet.* 108, 499. doi: 10.1037/0033-2909.108.3.499

Placky, B. W., Maibach, E., Witte, J., Ward, B., Seitter, K., Gardiner, N., et al. (2016). Climate matters: a comprehensive educational resource program for broadcast meteorologists. *Bullet. Am. Meteorol. Soc.* 97, 709–712. doi: 10.1175/BAMS-D-14-00235.1

Raacke, J., and Bonds-Raacke, J. (2008). MySpace and facebook: applying the uses and gratifications theory to exploring friend-networking sites. *Cyberpsychol. Behav.* 11, 169–174. doi: 10.1089/cpb.2007.0056

Renn, O., and Levine, D. (1991). *Credibility and Trust in Risk Communication in Communicating Risks to the Public*. Dordrecht: Springer, 175–217.

Rogers, E. M., and Kincaid, D. L. (1981). *Communication Networks: Toward a New Paradigm for Research*. New York, NY: Free Press.

Rousseau, D. M., Sitkin, S. B., Burt, R. S., and Camerer, C. (1998). Not so different after all: a cross-discipline view of trust. *Acad. Manage. Rev.* 23, 393–404. doi: 10.5465/amr.1998.926617

Rubin, A. M. (2009). *Uses-and-Gratifications Perspective on Media Effects*. London: Routledge, 181–200.

Rubin, A. M., Perse, E. M., and Powell, R. A. (1985). Loneliness, parasocial interaction, and local television news viewing. *Hum. Commun. Res.* 12, 155–180. doi: 10.1111/j.1468-2958.1985.tb00071.x

Rubin, A. M., and Windahl, S. (1986). The uses and dependency model of mass communication. *Crit. Stud. Media Commun.* 3, 184–199. doi: 10.1080/15295039609366643

Ruggiero, T. E. (2000). Uses and gratifications theory in the 21st century. *Mass Commun. Soc.* 3, 3–37. doi: 10.1207/S15327825MCS0301_02

Scheufele, D. A. (2013). Communicating science in social settings. *Proc. Nat. Acad. Sci.* 110(Supplement_3), 14040–14047. doi: 10.1073/pnas.1213275110

Sherman-Morris, K. (2005). Tornadoes, television and trust—A closer look at the influence of the local weathercaster during severe weather. *Environ. Hazards* 6, 201–210. doi: 10.1016/j.hazards.2006.10.002

Sherman-Morris, K. (2006). *A Place for PSI: Finding a Role for Parasocial Interaction in Hazards Research*. Tallahassee, FL: Florida State University.

Siegrist, M., Gutscher, H., and Earle, T. C. (2005). Perception of risk: the influence of general trust, and general confidence. *J. Risk Res.* 8, 145–156. doi: 10.1080/1366987032000105315

Skumanich, S. A., and Kintsfather, D. P. (1998). Individual media dependency relations within television shopping programming: a causal model reviewed and revised. *Commun. Res.* 25, 200–219. doi: 10.1177/009365098025002004

Slovic, P. (1993). Perceived risk, trust, and democracy. *Risk Anal.* 13, 675–682. doi: 10.1111/j.1539-6924.1993.tb01329.x

Slovic, P. (1999). Trust, emotion, sex, politics, and science: surveying the risk-assessment battlefield. *Risk Anal.* 19, 689–701. doi: 10.1111/j.1539-6924.1999.tb00439.x

Sodowsky, G. R., Kwan, K. L. K., and Pannu, R. (1995). "Ethnic identity of Asians in the United States," in *Handbook of Multicultural Counseling*, eds J. G. Ponterotto, J. M. Casas, L. A. Suzuki, and C. M. Alexander (Thousand Oaks, CA, US: Sage Publications, Inc), 123–154.

Spence, P. R., Lachlan, K. A., and Griffin, D. R. (2007). Crisis communication, race, and natural disasters. *J. Black Stu.* 37, 539–554. doi: 10.1177/0021934706296192

Spence, P. R., Lachlan, K. A., Omilion-Hodges, L. M., and Goddard, A. K. (2014). Being first means being credible? Examining the impact of message source on organizational reputation. *Commun. Res. Rep.* 31, 124–130. doi: 10.1080/08824096.2013.846259

Spence, P. R., Lachlan, K. A., Spates, S. A., and Lin, X. (2013a). Intercultural differences in responses to health messages on social media from spokespeople with varying levels of ethnic identity. *Comput. Hum. Behav.* 29, 1255–1259. doi: 10.1016/j.chb.2012.12.013

Spence, P. R., Lachlan, K. A., Westerman, D., and Spates, S. A. (2013b). Where the gates matter less: Ethnicity and perceived source credibility in social media health messages. *Howard J. Commun.*, 24, 1–16. doi: 10.1080/10646175.2013.748593

Sutter, D., and Flores, D. (2009). What drives television weather coverage? *Environ. Hazards* 8, 278–290. doi: 10.3763/ehaz.2009.0015

Teven, J. J., and McCroskey, J. C. (1997). The relationship of perceived teacher caring with student learning and teacher evaluation. *Commun. Educ.* 46, 1–9. doi: 10.1080/03634529709379069

Trumbo, C. W., and McComas, K. A. (2003). The function of credibility in information processing for risk perception. *Risk Anal. Int. J.* 23, 343–353. doi: 10.1111/1539-6924.00313

Wei, R. (2008). Motivations for using the mobile phone for mass communications and entertainment. *Telematic. Inf.* 25, 36–46. doi: 10.1016/j.tele.2006.03.001

Weibel, D., Wissmath, B., and Groner, R. (2008). How gender and age affect newscasters' credibility—an investigation in Switzerland. *J. Broadcast. Electr. Media* 52, 466–484. doi: 10.1080/08838150802205801

Werner, P. D., and LaRussa, G. W. (1985). Persistence and change in sex-role stereotypes. *Sex Roles* 12, 1089–1100. doi: 10.1007/BF00288107

Williams, F., Dordick, H., and Jesuale, H. (1985a). *Focus Group and Questionnaire Development for Exploring Attitudes Towards Telephone Service. Social Research and the Telephone*. Los Angeles, CA: Herbert Dordick and Associates.

Williams, F., Phillips, A. F., and Lum, P. (1985b). Gratifications associated with new communication technologies. *Media Gratific. Res. Curr. Persp.* 241–252.

Wilson, K. (2008). Television weathercasters as potentially prominent science communicators. *Pub. Understand. Sci.* 17, 73–87. doi: 10.1177/09636625060 65557

Wilson, K. M. (2002). Forecasting the future: how television weathercasters—attitudes and beliefs about climate change affect their cognitive knowledge on the science. *Sci. Commun.* 24, 246–268. doi: 10.1177/1075547022 37849

Wood, W., and Karten, S. J. (1986). Sex differences in interaction style as a product of perceived sex differences in competence. *J. Pers. Soc. Psychol.* 50, 341. doi: 10.1037/0022-3514.50.2.341

Wu, J. H., Wang, S. C., and Tsai, H. H. (2010). Falling in love with online games: the uses and gratifications perspective. *Comput. Hum. Behav.* 26, 1862–1871. doi: 10.1016/j.chb.2010.07.033

Yoo, C. Y. (2011). Modeling audience interactivity as the gratification-seeking process in online newspapers. *Commun. Theor.* 21, 67–89. doi: 10.1111/j.1468-2885.2010.01376.x

Zeng, L. (2011). More than audio on the go: Uses and gratifications of MP3 players. *Commun. Res. Rep.* 28, 97–108. doi: 10.1080/08824096.2011.541367

Zhao, X., Maibach, E., Gandy, J., Witte, J., Cullen, H., Klinger, B. A., et al. (2014). Climate change education through TV weathercasts: Results of a field experiment. *Bullet. Am. Meteorol. Soc.* 95, 117–130. doi: 10.1175/BAMS-D-12-00144.1