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Race and gender biases persist in public perceptions of scientists' credibility

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This study examines how race and gender stereotypes affect scientists' ability to communicate with diverse US public audiences. Through a unique collaboration between researchers and filmmakers, we conducted an online survey experiment with a nationally representative U.S. quota sample, including an oversample of Black respondents (*N* = 1637). We found that Black female scientists face challenges in being perceived as warm and competent compared to their peers. Our findings revealed significant intersectional biases: Black female scientists received the lowest ratings in both warmth and competence, with ratings dropping further when introducing a story about a White patient. Black male scientists received consistently high ratings across experimental conditions, particularly showing elevated warmth scores when discussing a Black protagonist with sickle cell anemia. They also maintained high competence ratings whether working with Black or White protagonists. This pattern suggests that while Black scientists generally faced discrimination, Black men's gender afforded them certain privileges that were not extended to Black women in scientific fields. Our findings highlight persistent, intersectional biases and emphasize the need for comprehensive approaches to diversity and inclusion in scientific communication, which includes addressing the prejudices faced by female scientists and scientists of color.

A growing body of scholarship sheds light on disparities in public engagement with emerging science and technologies, particularly racial and gender inequities and their interactions[1,2]. The conventional image of a scientist is often a White [A note on capitalization: There are varying perspectives among scholars and style guides regarding the capitalization of racial and ethnic identity terms. While acknowledging this ongoing discussion, for consistency in this manuscript, we capitalize both "Black" and "White" when referring to racial identities[3–6] male in a lab coat[7]. However, contemporary diversity, equity, and inclusion efforts advocate for scientists from diverse identities to actively interact with audiences and communicate their research findings. This juxtaposition of becoming emissaries for science (and for one's racial and gender identity in science) while navigating public perceptions creates a unique challenge for scientists from marginalized identities[8].

In this paper, we address three key research objectives related to these challenges. First, we investigate the impact of different representations of scientists on public perceptions of those scientists, focusing on how their perceived credibility varies by gender and race. Second, we explore whether an audience member's own race and gender influence their perceptions when the scientist has the same or different racial and gender characteristics. Lastly, we examine whether various sociodemographic factors of audience members, such as education, age, and political ideology, moderate these relationships.

As context for our study, we use the topic of the gene-editing tool CRISPR-Cas9. CRISPR has opened doors for treatment and potential cure of genetic diseases while raising moral, ethical, and political questions that necessitate public dialogue to chart appropriate ways forward[9,10]. Previous research has indicated that public opinion on CRISPR-based technologies is generally favorable, but support varies based on both the specific applications being proposed and socioeconomic differences among the public[11]. Given this, we use footage from the CRISPR-Cas9 documentary *Human Nature* as a real-world source of stimulus material for our study. The film delves into the intricacies of genetic editing, how it works, and its ethical dilemmas, making it a valuable resource for initiating public discourse and engaging audiences that have often been marginalized in science communication efforts.

Documentary films in general are trusted tools for science communication in the U.S[12,13]. and can improve science literacy and promote STEM diversity[14]. Research shows science videos can reduce educational knowledge

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gaps[15], provide valuable learning contexts[16], and help address gender bias[17]. While narrative storytelling in science documentaries can help reach non-expert audiences[18] and demonstrate science's relevance to daily life[19,20], the effectiveness of video communication—particularly for emerging technologies and diverse audiences—remains understudied.

Stereotypical representation of scientists in media

Alongside research into the power of video communication, there is the potential to improve science communication by portraying the scientific community as consisting of and valuing people across all racial and gender identities[21,22]. Research in healthcare finds that patients who have more visits with providers who share their racial identity exhibit higher levels of trust in doctors and healthcare providers[23]. Similarly, in the context of science communication, presenting diverse scientists who share the audience's race or gender could enhance their trust and engagement with scientific content.

Content analyses of mass media reveal that female scientists are often underrepresented[24–26]. When they are present, their expertise, authority, and competence tend to be downplayed, with communication instead focusing on their femininity or sexuality[27]. Interviews with students, particularly those of color, indicate that the stereotypical image of a scientist is typically White and male[28]. Recent progress has been made in the media representation of scientists; however, there is still room for improvement, particularly in representing female scientists and moving beyond the focus on balancing their family and career objectives[29]. Additionally, there is a need for better representation of scientists from diverse genders, as well as culturally and linguistically diverse identities[29].

How representation and implicit biases impact science practices

Scientific institutions also reflect and perpetuate cultural biases, contributing to workplace inequalities. Across scientific disciplines and sectors, a male-dominated field[30], women face systematic disadvantages, including receiving lower evaluations and salaries than equally qualified men[31,32]. Despite evidence that gender diversity enhances scientific teamwork and discovery, women's representation in science remains low[32]. Similarly, the U.S. scientific workforce lacks racial diversity[33]. Black Americans report skepticism about their acceptance in science[34], and institutional barriers persist, as evidenced by funding disparities between Black and White researchers with equal credentials[35] and movements like #BlackintheIvory highlighting racism in academia[36].

How intersectionality of identities influences bias

Implicit evaluative biases toward those with multiple marginalized social identities have compounded effects[37]. The compounded effect of intersectionality has been referred to as "double minority" or "gendered racism." Such bias can entail micro- and macro-aggressions and presumed lack of expertise, with consequences of feeling isolated and excluded for those who are experiencing bias[38]. Research finds that women from minority groups often bear the brunt of harmful stereotypes about the appearance of scientists[33]. Data absenteeism, or the absence or limits of data on groups experiencing social vulnerability, makes it difficult to collect information about those with intersectional identities and understand the lived reality of marginalized groups[39].

In addition to societal stereotypes and biases, the lack of role models and representation in the media can discourage talented individuals from pursuing science. Even with sufficient representation, diversity in science requires changes at the levels of recruitment, retention, education, and promotion of individuals to drive excellence[22]. All of the above is impossible without shifts in public attitudes and perceptions regarding who represents a capable scientist.

Therefore, we examine how audience perceptions of scientists' warmth and competence, two dimensions of credibility[40], vary for different representations of scientists in film. We focused on human gene editing through CRISPR, including its applications in treating two genetic diseases, sickle cell anemia, and albinism, and on the representation of scientists who vary by race and gender.

Warmth and competence are the two key dimensions of the stereotype content model. The stereotype content model identifies four prejudice types based on high versus low warmth and competence perceptions[41]: paternalistic prejudice (viewing groups as warm but incompetent, leading to pity), admiration (viewing groups as both warm and competent, leading to respect), contemptuous prejudice (viewing groups as neither warm nor competent, leading to scorn), and envious prejudice (viewing groups as competent but cold, leading to resentment). While scientists typically face envious prejudice (high competence, low warmth)[41], little research examines how scientist race and gender affect these perceptions. Traditional gender stereotypes tend to place women higher on warmth but lower on competence compared to men, while White Americans are stereotyped as high in both traits and Black Americans as lower in both, though these societal biases evolve over time[41]. Understanding how different social categories trigger varying prejudice types can inform efforts to address bias in STEM[41].

In our investigation of the main effects of the documentary clip on the perceived warmth and competence of the scientists, we included several moderators to examine their influence on audience attitudes. Previous literature suggests that various demographic factors can impact how individuals perceive and categorize others as similar or dissimilar to themselves[42,43]. We hypothesized that a range of demographic variables, including education level, race, gender, and political party preference, would influence the perception of the scientist in the documentary clip. These perceptions are shaped by the viewer's tendency to categorize the scientist based on the perceived demographic characteristics[43].

Furthermore, in the current social climate dominated by discussions on "Wokism", "Cancel Culture", racism, and social justice, interpretations of race and gender and of how to present one's stances on race and gender equity play crucial roles in people's self-reported perceptions[44]. We predicted that moral grandstanding—the act of aligning oneself with popular moral views for self-promotion—would be a significant factor, especially given the potential for social ostracism due to perceived moral transgressions[45]. By including these moderators, our experiment aimed to reveal how social and political factors shape the perceptions of scientists, contributing to our understanding of information processing and bias in this context. This approach allows us to explore some of the complex interplays between social cognition and interpersonal or intergroup reactions, providing a more comprehensive view of how audiences form impressions of scientists in media presentations.

This study emerged from a collaborative filmmaker-scientist partnership[46,47], enabling us to create professional-quality stimuli that enhanced external validity while maintaining experimental control. By combining documentary footage about CRISPR with introductions by experts of different races and genders, we examined how intersectional identities in science communication affect perceived credibility. This approach addresses research gaps in long-form video communication while providing a model for future practitioner-researcher collaborations.

Methods

Experimental design

To examine our research questions, we designed an experiment using a 4-by-2-by-2 factorial design in which respondents saw a one-minute video of actors portraying scientists ("narrator") that differed by two genders (female or male), two races (Black or White) and included two different actors for each race/gender combination, equated to eight different actors in total) as shown in Fig. 1. We intentionally included two actors to represent each gender/race condition to minimize the impact of potential variations in the quality of an individual actor's delivery, tone, attractiveness, and other confounding factors. Each actor read content from one of two scripts that either discussed the scientific impacts or the broader societal implications of CRISPR. All eight actors were informed that their participation was for social science research, and they provided consent to publish their likeness through their involvement in the study.

Then, viewers watched one of two 11-minute new short films edited from the documentary *Human Nature*. Each short featured a personal story of one of two children impacted by genetic diseases. The first is the story of Subject 1, who is a Black boy with sickle cell anemia, which is a disease that disproportionately affects Black Americans. The second story featured Subject 2, a White girl with albinism, a genetic disease not associated with a particular ethnicity. These were chosen to see if race and/or gender represented in the film impacted how audiences perceived the credibility of the narrator introducing the film. These new shorts were created to benefit from the realism of existing documentary footage while controlling for the quality, pacing, length, and storyline across the two stories. Release forms were obtained from both subjects and the legal guardians of Subjects 1 and 2 for the publication of identifying information and images.

Data and measures

This experiment was embedded in an online survey of U.S. adults conducted through Forthright, an online survey recruitment and fielding company, in December 2022. The final sample consisted of 1,637 U.S. adults ($N = 1637$) who were randomly assigned to one of 32 experimental conditions that varied across scientist gender (female/male), scientist race (Black/White), actor representation (two different actors per race/gender combination), patient scenario (Subject 1: Black child with sickle cell anemia, or Subject 2: White child with albinism), and introduction focus (scientific or societal impacts). The additional variation of two different introductory scripts was included for research questions addressed in different studies, while the focus of this research is on the effects based on the race and gender of the narrator and participant.

All methods were performed in accordance with the relevant guidelines and regulations. The University of Wisconsin-Madison Institutional Review Board approved the experimental protocols and informed consent was obtained from all participants before the study began. Participants were then provided with a broad definition of gene editing and CRISPR/Cas-9 and saw one of 32 stimuli after being randomly assigned to groups to ensure that

Fig. 1. Screenshots of the one-minute video clips of actors portraying scientists with gender and race variations.

each group represented a diverse and unbiased sample of the overall population. After the stimuli, we measured multiple outcome variables, described in the following sections.

Credibility After seeing the stimuli, participants were shown an image of the scientist they received and asked, "Thinking now about the scientist that you saw introduce the film clip, how much do you think each of the following applies?" The two source credibility measures were adapted from work by Fiske and Dupree (2014)[40] and Bigham, Meyers, and Li (2019)[48]. The measure for warmth is an average of responses to three items on a 7-point scale, ranging from "not at all" (0) to "extremely" (6) (M = 4.61, SD = 1.29); sincerity (M = 4.79, SD = 1.23) and relatability (M = 4.29, SD = 1.43). Cronbach's alpha for the warmth battery (M = 13.69, SD = 3.47) is 0.85. Similarly, to measure perceptions of the scientist's competence, we averaged responses to three questions capturing the dimensions of expertise (M = 4.64, SD = 1.23), knowledge (M = 4.98, SD = 1.09), and perceived competence (M = 4.83, SD = 1.19). Cronbach's alpha for competence battery (M = 14.45, SD = 3.14) is 0.88.

Moral grandstanding refers to the desire to be respected or admired for one's superior beliefs[45,49,50]. We included this as a potential moderating variable because of the likelihood that it would influence how participants rated the narrators based on their race and gender. Moral grandstanding was measured using three items from King et al. (2021)[49] to measure acknowledgment of the need for diversity (M = 5.57, SD = 1.23, Cronbach's Alpha = 0.90), three items from Leary et al. (2013)[50] to measure prestige (M = 5.27, SD = 1.11, Cronbach's Alpha = 0.85), and four items from Grubbs et al. (2019)[45] to measure the need to belong (M = 2.73, SD = 0.98, Cronbach's Alpha = 0.90).

Attitudes towards Black and White Americans were measured with a direct question asking respondents to rate their feelings towards particular societal groups on a thermometer from 0 to 100 (0 = not warm at all to 100 = extremely warm). This scale was adapted from measures in the American National Election Survey (ANES, 2018)[51]. Ten items asked about the participants' perceptions toward different entities, including Black/White Americans, liberals and conservatives, and medical doctors. Attitudes towards Black Americans resulted in 78% warmth on average (SD = 22) and 68% warmth towards White Americans (SD = 24). Cronbach's alpha for the feeling thermometers was 0.86.

Participant characteristics

The recruited participants were evenly split in gender (49.8% male; $n = 813$ and 50.2% female; $n = 821$) with a mean age of 46. We oversampled Black participants (46.8% Black; $n = 766$ and 47.0% White; $n = 770$), with the rest indicating they identify as more than one race. We deliberately oversampled race and gender characteristics to be able to examine group differences meaningfully. All other demographic data were weighted to ensure socio-demographic representativeness for gender and age in the US. Most (48.7%, $n = 796$) were high school graduates with a diploma or the equivalent (GED) or had received some college credit without getting a degree. 42% ($n = 693$) of participants indicated they had limited science experience by checking 1 out of 4 options that asked about their education and employment related to science.

Statistical analyses

We conducted an Analysis of Variance (ANOVA) to assess the main effects by comparing mean warmth and competence ratings across different conditions. Then we conducted a two-way ANOVA to explore the interaction effects between the scientists' gender and race on their warmth and competence ratings. Lastly, we conducted a three-way ANOVA to investigate further the interplay between the scientist's race, gender, and the race of the child featured in the documentary clip. We used SPSS for all statistical analyses and ensured that assumptions for ANOVA were met, including normality and homogeneity of variances. Bonferroni post hoc tests were conducted where necessary to further explore significant interactions and main effects. Specifically, these tests were employed when the ANOVA results indicated statistically significant differences ($p < .05$) between groups or significant interaction effects, allowing us to identify which particular group comparisons were driving these overall effects.

Results

Interactions in perceptions of warmth highlight costs of intersectionality for black female scientists

Main effects

We used ANOVA to compare the mean warmth ratings of scientists in each condition. We found significant main effects ($p < .05$) for the race of the scientist, the gender of the scientist, and the race of the child featured in the film clip. On average, the White scientists were rated higher in warmth (M = 4.36, SE = 0.06) than the Black scientist counterparts (M = 3.70, SE = 0.06). Male scientists were rated higher in warmth (M = 4.36, SE = 0.06) than their female scientist counterparts (M = 3.70, SE = 0.06). Scientists whose introductions were followed by a clip of Subject 1, a Black child with sickle cell anemia, were rated higher in warmth (M = 4.08, SE = 0.07) than scientists whose introductions preceded the clip of Subject 2 (M = 3.84, SE = 0.06), a White child with albinism.

Two-ways

A two-way ANOVA showed more nuanced patterns of warmth ratings among the conditions. When comparing the ratings of scientists who varied in gender and race, we found statistically significant ($p < .05$) differences between the means of each category. Black female scientists received the lowest mean ratings in warmth (M = 2.78, SE = 0.09), followed by White male scientists (M = 4.11, SE = 0.08), White female scientists (M = 4.59, SE = 0.08), and Black male scientists (M = 4.61, SE = 0.08) as shown in Fig. 2.

On average, Black scientists received significantly ($p < .05$) higher warmth ratings when their introduction was followed by the clip of the Black child with sickle cell anemia (M = 4.12, SE = 0.09), than when their introduction was followed by the clip of the White child with albinism (M = 3.27, SE = 0.08). Although the difference in means was smaller than their Black counterparts, White scientists received significantly lower ratings of warmth when

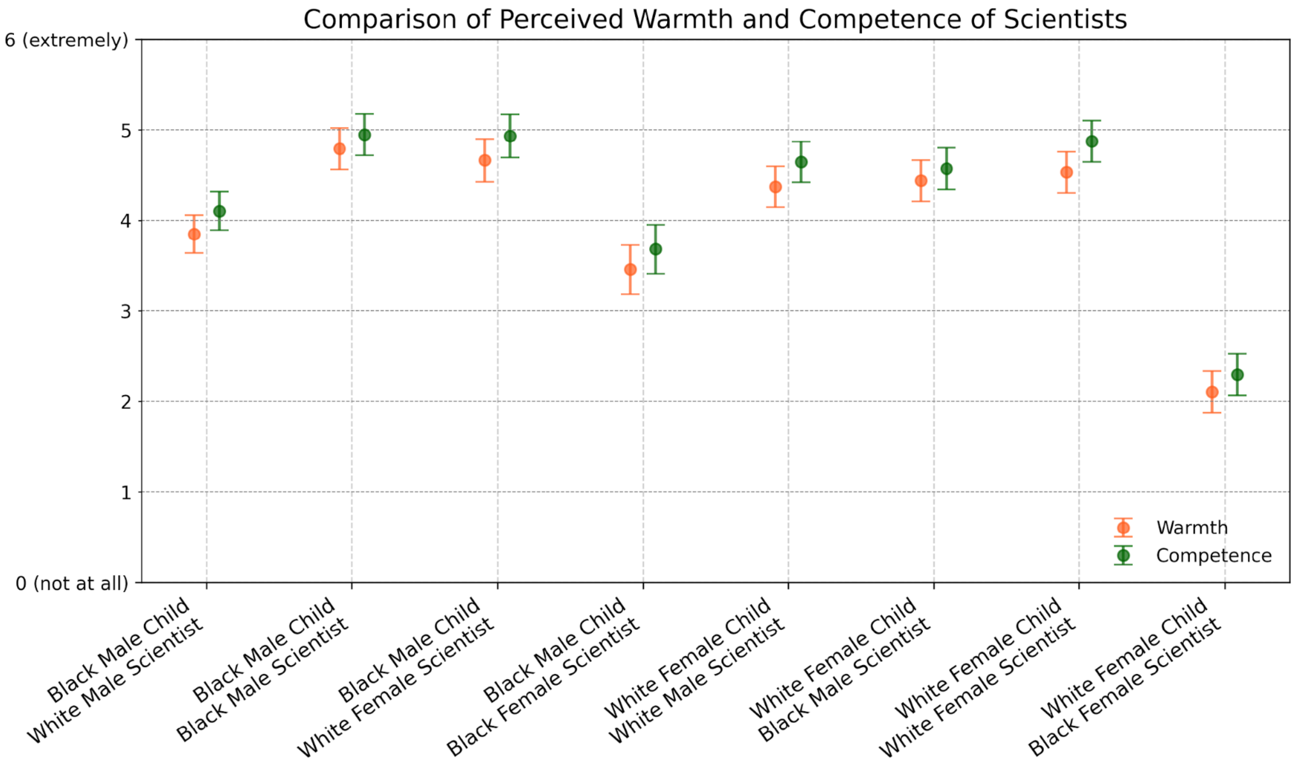

Fig. 2. Black female scientist and White female child pairing was deemed the lowest regarding the scientists' warmth and competence. The whiskers represent 95% CIs around the means.

they introduced Subject 1 (M = 4.25, SE = 0.08), than when they introduced Subject 2 (M = 4.45, SE = 0.08). On average, female scientists were rated significantly higher in warmth when their introductions were followed by the clip of Subject 1 (M = 4.06, SE = 0.09), than when followed by the clip of Subject 2 (M = 3.32, SE = 0.08). Male scientists had no statistically significant difference between their warmth ratings when introducing Subject 1 or Subject 2.

Three-ways
We also looked at the differences between warmth ratings of scientists by race and gender when introducing either Subject 1 or Subject 2. The scientists who received the highest warmth ratings when introducing the clip of Subject 1 were the Black male scientists (M = 4.81, SE = 0.11). White female scientists were rated second highest in warmth when introducing Subject 1 (M = 4.61, SE = 0.11), followed by white male scientists (M = 3.83, SE = 0.10). Black female scientists received the lowest warmth ratings when introducing Subject 1, compared to all other representations of scientists (M = 3.46, SE = 0.14).

This pattern shifted slightly for warmth ratings when scientists introduced the clip of Subject 2. White female scientists received the highest warmth ratings when introducing Subject 2's clip (M = 4.45, SE = 0.11), followed by Black male scientists (M = 4.42, SE = 0.11), White male scientists (M = 4.35, SE = 0.11), and finally Black female scientists (M = 2.12, SE = 0.11).

Interactions in perceptions of competence further emphasize intersectionality costs for black female scientists

Main effects
Our analysis uncovered similar patterns of significance in respondents' average competence ratings of different scientists. We found significant main effects ($p < .05$) for the race of the scientist, the gender of the scientist, and the race of the child featured in the film clip. On average, the White scientists were rated significantly higher in competence (M = 4.53, SE = 0.06) than the Black scientist counterparts (M = 3.87, SE = 0.06). Male scientists were rated higher in competence (M = 4.56, SE = 0.06) than their female scientist counterparts (M = 3.94, SE = 0.06). Scientists whose introductions were followed by a clip of Subject 1 were rated higher in competence (M = 4.41, SE = 0.06) than scientists whose introductions preceded the clip of Subject 2 (M = 4.09, SE = 0.06).

Two-ways
For perceptions of competence, our two-way ANOVA showed similar statistically significant findings. When the average competence ratings of scientists who varied in gender and race were compared, we found statistically significant ($p < .05$) differences between the means of each category. Most starkly, Black female scientists received the lowest mean ratings in competence (M = 2.99, SE = 0.09), followed by White male scientists (M = 4.37, SE = 0.08), Black male scientists (M = 4.76, SE = 0.08), and White female scientists (M = 4.90, SE = 0.09).

On average, Black scientists received significantly ($p < .05$) higher competence ratings when their introduction was followed by the clip of Subject 1, the Black, male, protagonist, (M = 4.31, SE = 0.09), than when their introduction was followed by the clip of Subject 2, the White, female, protagonist (M = 3.43, SE = 0.08). White scientists received significantly lower ratings of competence when they introduced Subject 1 (M = 4.52, SE = 0.08) than when they introduced Subject 2 (M = 4.76, SE = 0.08).

Female scientists were rated significantly higher in competence when their introductions were followed by the clip of Subject 1 (M = 4.30, SE = 0.08), than when followed by the clip of Subject 2 (M = 3.58, SE = 0.08). Male scientists had no statistically significant difference between their average competence ratings when introducing Subject 1 or Subject 2.

Three-ways

We analyzed the differences between the competence ratings of the scientists introducing Subject 1 and Subject 2 by race and gender to understand more nuanced differences. The scientists who received the highest competence ratings when introducing the clip of Subject 1 were the Black male scientists (M = 4.94, SE = 0.12). White female scientists were rated second highest in competence when introducing Subject 1 (M = 4.93, SE = 0.12), followed by White male scientists (M = 4.10, SE = 0.11). Black female scientists received the lowest ratings of the different representations of scientists when introducing Subject 1 (M = 3.68, SE = 0.14).

This pattern shifted for competence ratings when scientists introduced the clip of Subject 2. White female scientists received the highest competence ratings when introducing this clip (M = 4.87, SE = 0.12), followed by White male scientists (M = 4.64, SE = 0.11), Black male scientists (M = 4.57, SE = 0.12), and finally Black female scientists (M = 2.29, SE = 0.12).

Feeling thermometer

The feeling thermometer that we used to measure respondents' general attitudes towards Black and White Americans also had a statistically significant main effect on ratings of competence of all scientists. On average, respondents with more positive feelings toward Black Americans rated all scientists with higher scores on competence. However, feelings towards both racial groups did not serve as significant moderators on people's ratings of scientists within each stimuli group.

Moderator interactions

We found no moderation effects when accounting for moral grandstanding, political party preference, education, or the participant's race or gender. The absence of moderation suggests that perceptions of scientists, based on varying representations and identities, remained consistent across these factors, highlighting the robustness of our findings from the main effects.

Discussion

Our findings shed light on the interplay of race and gender and its continued impact on the American public's perception of scientists' credibility, an effect that varies with presentation content. Scientists who introduced the clip of a White protagonist with albinism (Subject 2) received lower ratings in warmth and competence compared to those who introduced the clip of a Black protagonist with sickle cell anemia (Subject 1). This pattern manifested differently across racial groups: White scientists received higher credibility ratings when introducing Subject 2, while Black scientists received higher ratings when introducing Subject 1. These findings demonstrate that audience perceptions of credibility arise from the intersection of scientists' identities, subject matter, and audience biases, rather than from demographic characteristics alone.

We also found intersectional patterns in how scientists' credibility was perceived that demonstrate that race and gender interact rather than operate independently. While male or White scientists generally received higher ratings, the combinations of race and gender revealed specific differences: Black male scientists rated highest in warmth, followed by White female scientists, White male scientists, and Black female scientists. For competence, White female scientists and Black male scientists switched positions, with the former rated highest, followed by Black male scientists, and then White male scientists and Black female scientists again with the next lowest and lowest ratings. Black female scientists consistently received the lowest ratings across both warmth and competence, with their ratings dropping even further when introducing the White female protagonist., These findings demonstrate how intersecting racial and gender identities create unique disadvantages that persist across participant demographics, exemplifying what Black feminist scholars termed "double jeopardy" – where the convergence of marginalized identities compounds rather than merely adds disadvantages[52].

The data reveals interesting, distinct patterns on how scientists are perceived based on race-gender combinations and patient pairings that make more sense through the lens of the four prejudice types of the stereotype content model[41]. Admiration (high warmth – high competence) was most evident when Black male scientists presented the case of the Black protagonist with sickle cell anemia, suggesting audiences respond most positively when they perceive demographic "matching" between patient and scientist. The finding aligns with several theoretical frameworks such as concordance theory in healthcare, which shows improved outcomes when patients and providers share racial identities[53] and cultural competence in healthcare communication which suggests that audiences may perceive Black scientists as having unique insight into health conditions affecting the Black community[54].

White female scientists in the study consistently received high ratings in both warmth and competence, suggesting they elicited admiration rather than the paternalistic prejudice often associated with women in STEM. White male scientists received notably lower ratings than their female counterparts in both warmth and competence. This pattern persisted across contexts, though both groups were rated somewhat differently depending on which subject they introduced. White male scientists particularly received lower ratings when discussing the Black protagonist with sickle cell anemia compared to the White protagonist with albinism. The high warmth and competence ratings for White female scientists are supported by previous research showing how women in healthcare might receive higher trust ratings when discussing pediatric cases and how gender stereotypes about nurturing qualities can paradoxically advantage women in specific professional contexts while reinforcing broader gender constraints[55].

Contemptuous prejudice (low warmth, low competence) was most strongly directed at Black female scientists, particularly when presenting the White female protagonist's s case, representing the most severe form of bias with consistently low ratings across both measures. This pattern aligns with research on how intersectional prejudice affects Black women in professional settings, where they face unique forms of discrimination that differ from both Black men and White women[56]. These findings demonstrate how intersecting identities of both scientists and patients shape public perceptions of scientific credibility, highlighting the need for targeted interventions that address multiple forms of prejudice in scientific communication.

This bias persists despite broader positive attitudes toward marginalized groups: when participants rated how warm they found various groups in society on a scale from 0 to 100, both Black Americans (76%) and Women (79%) received high ratings. The disconnect between these favorable general attitudes and the low credibility ratings of Black female scientists reveals how professional contexts can activate distinct prejudices that override seemingly positive broader social attitudes.

These findings illustrate that the chronic lack of representation or negative representation of Black female scientists, both within scientific institutions and media portrayals, has perpetuated the stereotypical image of scientists. These, in turn, may exacerbate social inequities in science. While representation is important, additional changes beyond having a diverse spokesperson are also needed to overcome the existing biases in the institutions and the public[57]. The research also points to the compounding effect that both marginalized race and gender can play in essentially doubling down on the negative assessment of the scientist's credibility. In the wake of events such as the murder of George Floyd, institutions and individuals alike collectively strengthened calls for racial justice and the reimagining of diversity initiatives to address structural biases and the harms they place disproportionately on Black Americans[58]. Our results find that even after controlling for reflexive virtue signaling or moral grandstanding when asked about the Black American community, tension remains where the audience continues to display implicit biases.

The study's results further highlight the particular need in science communication to acknowledge implicit bias in the public attitudes toward Black female scientists and experts, especially regarding the understudied area of scientists communicating directly with the public. These scientists may be disincentivized from public engagement due to documented challenges including misogynistic comments online and lack of institutional support[59,60] – barriers that could help explain the lower credibility ratings we observed in our study. Thus, Black female scientists' challenges in research promotion, public engagement, and education efforts should be understood to be uniquely challenging compared to that of their colleagues, and they should receive tailored support in their efforts to diversify the representation of scientists. Even as we address recruitment bottlenecks and retention challenges, we must recognize that it takes a long journey to foster acceptance of scientists who defy outdated stereotypes, ensuring credibility, inclusivity, and rigor across the scientific community.

The study investigated how implicit biases impact society's perception of Black female scientists using realistic materials from a film that audiences might encounter. While this method may introduce additional variables and compromise internal validity, we made efforts to control variables such as the race and gender of hypothetical patients featured in the films. By highlighting the real-world implications of these biases, the study underscores the importance of a nuanced approach that effectively balances both internal and external validity. This recognition of complexity is essential in comprehensively addressing racial and gender biases in perceptions of the credibility of scientists.

Additionally, this study capitalized on a unique research-practice partnership between social scientists and filmmakers. Collaborations like this model a pathway forward for science communication that combines social scientific research on human decision-making processes with real-world efforts to communicate breakthrough science, such as human gene editing. Research-practice partnerships will be increasingly important as scientists, social scientists, and science communicators expand and evaluate their toolkits for communicating and engaging audiences typically underserved by science[56]. This collaboration indicates how research-practice partnerships can yield mutual benefits, such as producing high-quality video stimuli for experiments and insights from research that can impact the future of science documentaries. The collaborative effort between the filmmakers and scientists in studying engagement was mutually beneficial, where filmmakers better understood the social science research process, and social scientists learned about the creative process in filmmaking. Film offers a potentially promising area for advancing research and communication, particularly in its potential to make information on emerging scientific topics accessible to diverse audiences.

Limitations

It is important, of course, not to overstate the lessons from this initial study of public responses to scientific communicators. Although our study paired a scientist with a subject in the same documentary video, their relations are indirect because they are not involved in the subjects' diagnoses or treatments. While it could be argued that the association between the two subjects would be weak, these findings show a repeated pattern of lower credibility given towards the Black female scientists, which indicates that a strong connection determined participants' perceptions. Our study also faced the limitation of categorizing race and gender, which are socially constructed and fluid in nature, as binary categories (White/Black and male/female) assumed from the scientists' appearances. In classifying our scientific narrator actors and research participants, this categorization does not shed light on the experience of those who identify outside of these rigid binary categories, nor does it allow for the expression of additional intersecting identity characteristics[61]. Science communication must therefore consider ways to expand the many dimensions of representation in research and practice.

Data availability

Anonymized data created for the study are available in a permanent repository upon publication (The raw dataset can be downloaded directly from this link): https://github.com/uwlscscimep/Scientist-Credibility/blob/a330a2069b92e6dc5a37ce835c6d1ee0aea4cf7f/Scientist_Credibility_Data.csv.

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Designed research: AM, EH, MD, EK, SG, DS. Performed research: AM, EH, DS. Analyzed data: DE, AM, HT, EH, DS. Wrote the paper: DE, AM, HT, EH, MD, EK, SG, DS. Provided feedback on the manuscript: DS, DE, SG, EH

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Declarations

Competing interests

The authors declare no competing interests.

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Additional information

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