

# I am a scientist . . . Ask Me Anything: Examining differences between male and female scientists participating in a Reddit AMA session

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## Abstract

This article investigates interactions between scientists and the online community Reddit. Given that past research on computer-mediated communication between scientists and the public found that male scientists are typically more popular in online spaces than female scientists, we examined differences in popularity as well as potential gendered differences in communication style. Specifically, we examined 269 Reddit “Ask Me Anything” sessions as well as the comments linked with each session ( $n = 125,580$ ). Overall, we find that male scientists receive more comments on their sessions, but the score an individual comment receives does not differ by gender. Similarly, we find that the message complexity of the comments does not differ by gender. Taken together, these suggest that Reddit AMA sessions might be an effective platform for both male and female scientists to engage with the public.

## Keywords

gender and science, interactions expert/publics, online communication, outreach and engagement, scientist public engagement

Female scientists are historically underrepresented in the academy and industry (AAUW, 2020; Hur et al., 2017). Much research has investigated how to counteract this persistent gender gap. One efficacious strategy for recruiting more women into the sciences is increasing the visibility of female scientists to the public as it provides young females role models and helps combat negative stereotypes about female scientists (Carli et al., 2016; Kanny et al., 2014; Luong et al., 2020). To increase the visibility of female scientists, female scientists themselves must participate in public engagement activities, such as interacting with news media or building a social media presence.

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Prior research shows that although both male and female scientists have equally positive attitudes toward and willingness to engage in public engagement activities, male scientists are more likely than their female counterparts to have *actually* participated in public engagement activities aimed toward a large audience (e.g. news media interviews or creating a social media presence; Anzivino, 2021; Crettaz von Roten, 2011). This discrepancy between positive attitudes, intentions and behavior is puzzling as it suggests that something prevents female scientists from participating in public engagement activities.

One plausible explanation is that when female scientists *have* engaged with the public, their efforts have been met with backlash, discouraging further public engagement. For example, in interactions with members of the public, female scientists often experience harassment and have their credibility undermined (Amarasekara and Grant, 2019; McDonald et al., 2020). In order to counteract this treatment, McDonald et al. (2020) found that female science communicators prefer anonymized outreach activities. One viable public engagement option, therefore, could be participating in a “Ask Me Anything” (AMA) session on the popular online social network site (SNS) Reddit. During the scientist’s AMA session, they communicate with members on the site via a written question and answer format, negating the need for the scientist to record their appearance or voice. Examining this written format provides a unique opportunity to both ascertain how scientists interact with the public (e.g. are there differences in the ways that male and female scientists communicate) *and* evaluate how they are received on the platform.

This investigation, therefore, focuses on Reddit which is a popular website with a large audience of over 330 million active users and over 21 billion monthly screen views (Foundation, 2021). The main function of Reddit is for users to engage in conversations. The overall platform is made up of individual “subreddits” which are forums dedicated to specific topics where users post and comment information pertaining. A popular feature of the r/science subreddit is hosting AMA sessions in conjunction with another popular subreddit r/IAmA. Between the years of 2014 to 2018, the site hosted up to five science-related AMA sessions weekly (Wikipedia, 2021). Given the popularity of science on Reddit, researchers have begun to investigate its utility for effective public engagement.

While Reddit AMAs seem to be effective for scientists to engage with a segment of the public, little is known about how scientists are received. It is vital, therefore, that we focus attention on assessing how male and female scientists are received during AMAs. To address this gap in the literature, we investigate 457 AMA sessions and 125,580 comments responding to these sessions. Specifically, we examine differences in how female and male scientists are received based upon quantitative metrics (session and comment score) and qualitative metrics (comment sentiment and message complexity) as well as how the quantitative metrics are influenced by the scientist’s communication style.

## I. Literature review

There is a persistent gender gap between male and female scientists in both the Science, Technology, Engineering, and Mathematics and the social and behavioral branches of the sciences (AAUW, 2020; Hur et al., 2017). While major systemic changes are needed within the academy and industry to combat gender disparities, one short-term solution to this problem is to recruit more females to the sciences (Kanny et al., 2014). However, there are societal obstacles that deter females from entering the sciences both in high school and as undergraduates. For one, negative stereotypes about female scientists are persistent among the general public. For example, Carli et al. (2016) found that individuals perceive females as lacking the qualities necessary to be scientists (e.g. females are too communal and lack agency).

Unfortunately, media portrayals of female scientists do little to negate harmful stereotypes and instead reinforce them. Indeed, Chimba and Kitzinger (2010) found that mass media portrayals of female scientists often focus on appearance rather than accomplishments. Similarly, content analyses of news media portrayals of female scientists observed that news media often focus on female scientists' personal rather than professional lives (Mitchell and McKinnon, 2019; Steinke, 2012). Given that mass media portrayals often affirm negative stereotypes about female scientists, rather than challenge them, we need to study other ways of increasing the visibility of female scientists. One way to increase the visibility of current female scientists is having them interact with members of the public directly through public engagement activities.

Public engagement activities are "any type of planned interaction where scientists communicate with adult non-scientists about science and technology outside of a classroom setting" (Besley, 2015: 202). Examples of public engagement activities range from informal activities such as science pub nights to writing op-eds. Traditionally, effective public engagement activities were carried out to educate the general public about science. Therefore, these activities modeled a top-down, unidirectional approach (Brossard and Lewenstein, 2009). In the past decade, however, science communication professionals have urged scientists to engage in bidirectional activities, which focus on engaging the public in a dialogue about science (Brossard and Lewenstein, 2009).

Bidirectional public engagement activities, such as mentoring high school students, are effective for increasing female high school students' intentions to major in a STEM-related subject (Breda et al., 2021). Female scientists are often encouraged to engage in these mentorship roles so that they can serve as role models for young girls (AbiGhannam, 2016; Fogg-Rogers et al., 2017). This type of bidirectional public engagement activity, while beneficial for the greater public good, is time expensive. Bidirectional engagement activities often involve scientists devoting time to developing relationships with members of the public or spending time preparing and tailoring messages for specific audiences (Yuan et al., 2017). Given that time is a scarce resource for many scientists (McClain and Neeley, 2015), scientists tend to prefer unidirectional communication activities with a known time investment (Dudo and Besley, 2016; Yuan et al., 2017). As an alternative, science communication scholars have begun to investigate whether SNSs could be a less time-consuming platform for bidirectional public engagement.

### *Female scientists and online public engagement with science*

Social network sites provide scientists with an opportunity to engage, excite, and educate the public about science (McClain and Neeley, 2015). Members of the public themselves have reported they turn to SNSs such as Twitter to stay up to date on scientific news (Huber et al., 2019; Mueller-Herbst et al., 2020). These platforms afford scientists the opportunity to interact directly with the public. For example, a scientist can create a YouTube channel where they post videos explaining their research, increasing their visibility. Van Eperen and Marincola (2011), furthermore, found that 77% of life scientists have a social media account and that these scientists view their account as a platform for engaging with their colleagues *and* members of the general public.

Given that scientists are using SNSs for public engagement, a growing body of research has evaluated the interactions between scientists and members of the public on these platforms. Previous studies of scientists' online public engagement have found that the gender of the scientists utilizing online TED Talks (Sugimoto et al., 2013), YouTube (Amarasekara and Grant, 2019), and Twitter (Ke et al., 2017) skews male. While this discrepancy could exist because there are more males in the sciences, another explanation is that there might both be differences in the ways male and female scientists communicate online with members of the public *and* in the way they are received online. Findings from past research support this speculation as male scientists typically

accrue more likes and views on YouTube while female scientists receive more hostile and sexist comments (Amarasekara and Grant, 2019; Sugimoto et al., 2013). This possibility is further supported by McDonald et al. (2020) survey of female online science professional communicators, which found that the majority had experienced sexual harassment online.

In order to combat online harassment, female science communicators and scientists have adapted their communication style and methods. For example, some female science communicators prefer online engagement activities where their faces are not featured (e.g. voicing over a video), while others prefer engagement activities where neither their appearance nor voice is featured, which limits the likelihood of poor reception from the public (McDonald et al., 2020). Given that participating in a Reddit AMA enables communication where one's appearance and voice is not featured, this could be an attractive online public engagement activity for female scientists. While previous research has examined the extent to which female scientists have participated in public engagement activities on other online platforms, such as YouTube, little is known about the extent to which female scientists are already participating in Reddit AMAs. A recent study began to address this question by conducting a case study of six r/IAmA AMA sessions, which observed that participating scientists were predominantly male (Hara et al., 2019). Whether this observation applies to overall participation in Reddit AMAs is unknown; therefore, we posit the following:

RQ1: What is the distribution of male and female scientists participating in Reddit AMA sessions?

On Reddit, there are several quantitative metrics that might provide an indication of how scientists are received. First, we can examine how many comments a post receives, as this might indicate interest. Indeed, Welbourne and Grant (2016) measured YouTube channel popularity by examining the number of comments and likes a video received and found that male scientists received more comments and likes than their female counterparts. On Reddit, individuals also have the ability to rate a session and comment by either "upvoting" it or "downvoting" it. In general, "upvotes" are Reddit users' (otherwise known as "redditors") method for indicating their approval of a post or comment while "downvoting" indicates that the individual disapproved of the content. While there are likely some nuances to the action of upvoting/downvoting, according to previous research (e.g. Hayes et al., 2016; Leavitt and Robinson, 2017) it serves as a good proxy for approval toward posted content. Thus, each session and comment have a total score, which is the total number of upvotes the session or comment receives minus the total number of downvotes the session or comment receives. It is important that we examine both metrics because they tap into different audience responses. For one, examining the number of comments a session receives likely taps the amount of active engagement a session receives while the score measures aggregate approval. For example, a session hosted by a female scientist could receive substantial engagement as evidenced through many comments, but it could still receive a low session score which would indicate low approval from Reddit users. While the way that female scientists are received on Reddit is currently an open question, other investigations into how female scientists are treated by the public have consistently found that male scientists are generally more popular than their female counterparts. On YouTube, for example, videos created by male scientists typically receive more views and likes than videos created by female scientists (Amarasekara and Grant, 2019; Sugimoto et al., 2013). This could be because, demographically, YouTube users skew male (Omnico, 2021) who may be more receptive to male scientists than female scientists. On Reddit, the demographic makeup of users is similar (Barthel et al., 2016). Given this, one might predict that the Reddit community would behave in a similar manner as users on YouTube. News media, furthermore, focuses on

female scientists' personal lives rather than professional lives, further perpetuating negative stereotypes about women scientists (Mitchell and McKinnon, 2019; Steinke, 2012). Taken together, we hypothesize that male scientists receive more positive reception on AMA sessions:

*H1*: Male scientists will receive more comments on their AMA session than female scientists.

*H2*: Male scientists will receive a higher score on their AMA session than female scientists.

*H3*: Male scientists will receive a higher score on their individual comments during the AMA session as compared to female scientists.

Beyond categorizing count metrics, it is important to examine how other factors, such as communication style, affect how male and female scientists are received on Reddit.

### *Female scientists and communication style*

When participating in a public engagement activity, scientists are urged to make their language accessible to a general audience (Sharon and Baram-Tsabari, 2014). Accessibility can be accomplished by using plain language descriptions of their science, rather than relying on jargon (Sharon and Baram-Tsabari, 2014). Jargon is defined as "special words or expressions that are used by a particular profession or group and are difficult for others to understand" (Oxford Languages, n.d.). While jargon can be useful for ingroup communication, such as communication between colleagues, it can be difficult for outgroup members to understand. Reducing jargon is important for written interactions between scientists and members of the public as jargon can impede an individual's ability to engage with the information (Bullock et al., 2019). In the research reported here, we operationalize jargon as complex language as defined by the Flesch (1948) Reading Ease Scale. This operationalization has been used by other investigations into the effects of jargon on the individual (e.g. Shulman and Sweitzer, 2017).

While the use of jargon can impede science communication efforts (Bullock et al., 2019), jargon can also serve as an important heuristic, signaling that the speaker is an expert on the matter (Zimmermann and Jucks, 2018). Perceived source credibility is typically broken into two dimensions: one's perceived trustworthiness and one's perceived competence to speak on the matter (Hovland and Weiss, 1951; Lupia, 2013; Metzger et al., 2003). An individual can determine whether another individual is competent to speak on the subject matter by examining credentials or by using their language as a heuristic cue (Toma and D'Angelo, 2015). Zimmermann and Jucks (2018), for example, found that medical doctors who used technical jargon in an online health forum were rated as more trustworthy *and* more competent compared to medical doctors who did not use technical jargon. Similarly, Scharrer et al. (2017) found that when the language used by experts is "too easy" to understand, individuals overestimated their ability to make judgments about scientific claims and no longer believed they needed to rely on a scientific expert's assessment. Taken together, jargon serves as an important heuristic for individuals to determine scientific expertise. This is further evidenced within the subreddit *r/science*, as posts that used more complex language received higher scores than posts with less complex language (Hubner et al., 2021).

These studies raise important questions about the practical implications of advising scientists to remove jargon from their vocabulary when communicating with the public, as a reduction in jargon could diminish perceptions of the scientist's credibility (Scharrer et al., 2017). Given the consistent findings that messages with complex language receive greater affirmation from audience members than messages that do not use complex language, we predict that the comments written by the

scientists who use more complex language will receive more upvotes than comments with less complex language.

*H4:* Comments with more complex language will receive a higher comment score than comments that do not use complex language.

Previous work investigating the relationship between scientists and jargon have not taken gender into account, both in the use of jargon *and* in how audience members evaluate speaker credibility. First, it is an open question whether there are differences between male and female scientists in their use of jargon when communicating with lay audiences. On the one hand, female scientists might be more likely to use jargon as they might perceive it bolsters their credibility. For example, a survey of female science communicators reported that they often report their credentials to begin public communications *and* are more likely to describe their science using technical, data driven examples rather than anecdotes (McDonald et al., 2020). Similarly, AbiGhannam (2016) interviewed professional, online science communicators and found that they were equally likely to describe science in technical terms as they were to interject personal anecdotes in their explanations. This suggests that female scientists might strategically use jargon to bolster their credibility during public outreach activities.

Beyond using jargon to bolster credibility, scientists might use it when engaging with the public simply because it is difficult for them to remove jargon from their vocabulary. During interviews with professional science communicators, Yuan et al. (2017) reported that professionals felt as though scientists often fail to take into account their audience and consequently do not think about their audience's level of understanding. On the other hand, Herring (2003) investigated male and female political bloggers and found that women bloggers were more likely to explain political processes at length. Given the mixed findings, we posit the following research question:

*RQ2:* Is there a difference in the language complexity used by female scientists in their comments compared to male scientists?

It is likely that the gender of the scientist influences the relationship between message complexity and the score a comment receives for two reasons. First, scientists are stereotypically believed to be career-focused, frank, knowledgeable about science, technically skilled, logical, and well-informed (Carli et al., 2016; Losh, 2010). Scientists, furthermore, are perceived as individuals who are competent at their jobs but lack warmth and empathy (Fiske and Dupree, 2014). These beliefs may lend themselves to the expectation that scientists might use language in their communications with the general public that are difficult for lay audiences to understand (Scharrer et al., 2017). Similar to beliefs about a stereotypical scientist, stereotypical males are also perceived as highly agentic, competent, technically skilled and logical (Carli et al., 2016). Thus, one might expect that male scientists use complex language when communicating as it fits expectations for both how a scientist and a male should behave.

The stereotypical female, on the other hand, is perceived as warm and expressive, dependent, nice and nurturing (Carli et al., 2016; Eagly and Mladinic, 1994), all of which are traits that are perceived as incompatible with being a successful scientist (Carli et al., 2016; Eagly and Mladinic, 1994). Media depictions of female scientists do little to challenge these stereotypes, as female scientists are often quoted in order to "humanize" science (Chimba and Kitzinger, 2010; Mitchell and McKinnon, 2019). As such, portrayals of female scientists do not typically cast them as embodying stereotypical scientist traits, rather focusing on the female's appearance (Chimba and Kitzinger, 2010). Similarly,



females are often cast as assistants to a male scientist, rather than an independent scientist (Schibeci and Lee, 2003; Steinke, 2005). Given that females are expected to be warm, expressive, and dependent on a male's lead, one might expect that females, regardless of their vocation, use simple language that is devoid of complex terms to make their language accessible. If a female scientist violates this expectation by using complex language, an expectancy violation might occur.

According to expectancy violation theory (Burgoon and Le Poire, 1993), individuals have expectations, based on societal norms, about what is typical and appropriate for certain scenarios and people. When these expectations are violated, individuals experience psychological discomfort, and they use these feelings to form attitudes toward the person or situation (Burgoon and Le Poire, 1993). For example, if an individual believes that all scientists are introverted meet a scientist who is overly friendly, their expectation about the scientist was violated. Because the individual experienced an expectancy violation, they might develop a negative attitude toward the scientist. Therefore, individuals who encounter a male scientist using complex language might evaluate the language positively as it conforms to their expectations for how scientists and males should communicate. In contrast, if they encounter a female scientist who is using complex language, this might violate their expectations and lead to evaluating the message unfavorably. Meier et al. (2020) found some support for this hypothesis when they evaluated the language used by males and females who have given a TED Talk. Specifically, females who embraced female communication stereotypes by exuding warmth and using a narrative style for scientific explanations received higher ratings on recorded talks than females who used a more analytically, stereotypical male style. Therefore, we hypothesize the following:

*H5:* The influence of complex language on comment score will be moderated by the gender of the scientist, where males who use complex language will receive a higher comment score than females who use complex language.

In addition to examining quantitative count data, it is also important that we examine how female scientists are received on the Reddit. Previous research has found that female scientists commonly experience harassment during and after public engagement activities. For example, female scientists are often the target of cyber harassment after being quoted by news media (Samer et al., 2021). The majority of female science communicators, furthermore, report that they have had negative, harassing comments directed at them related to public engagement activities. As such, it is important we examine whether female scientists experienced backlash from the Reddit community during their AMA.

Previous researchers have tapped into how male and female scientists are received in online spaces by examining the sentiment of comments left by the public. For example, Tsou et al. (2014) examined comments on TED Talk videos on YouTube and the TED Talk site and found that female scientists receive more emotionally-charged comments—both negative and positive—than their male colleagues. Amarasekara and Grant (2019), however, examined comments left on male and female scientists' YouTube videos and found that male scientists receive more negative comments than female scientists. Similarly, they reported that female scientists received more positive-sentiment comments than their male counterparts (Amarasekara and Grant, 2019). Given these findings, it is unclear how the sentiment of the comments directed toward scientists may differ in terms of gender. Therefore, we offer the following final research question:

*RQ3:* Is there a difference between the sentiment of comments directed toward male and female scientists?

## 2. Method

We collected all science-related AMA posts from January 1, 2016 through December 31, 2018 ( $n=583$ ). Seven research assistants identified the names of the scientists participating in the AMA session by reading the introductory post. Then, research assistants determined if the scientist had schooling past a bachelor's degree (e.g. graduate student and beyond) by examining the scientist's introductory post. Generally, the introductory post would indicate training and current position. For example, the post might read, "Hello! My name is Sam Smith, I am an assistant professor of geology at Smith University." If the post did not indicate the scientist's level of training, then the research assistant performed an Internet search and examined profiles of the scientists to determine the scientist's level of training. If the individual did not have formal education beyond a bachelor's degree, then they were removed from our sample ( $n=126$  were removed at this stage). We removed these individuals from our sample because we were interested in the reception of *experts* communicating science with the public.<sup>1</sup> If the individual met our inclusion criterion, research assistants searched for the scientist's demographic information by performing an Internet search for the name of the scientist and searching through relevant websites for information (e.g. university websites, Google Scholar profiles, personal websites, etc.). We describe each of the variables of interest in more detail below. After excluding individuals who did not meet our inclusion parameters, our study population included a total of 457 unique AMA sessions with a total of 755 scientists.<sup>2</sup>

### Presenter demographics

**Gender.** By examining the individual's profiles on various websites and SNSs, the research assistants identified whether the individual presented as male or female.

### Post and comment characteristics

**Number of comments.** We collected all comments related to each AMA session by first collecting the direct comments to the post, then the comments on the first-level comments, and so on, until all associated comments related to the post were included. On average, posts received 1690 ( $SD=4107.63$ ) comments in their full comment tree. Conceptually, the number of comments a session received might indicate the degree of interest in the session.

**Post and comment score.** On Reddit, users are able to "upvote" and "downvote" posts. Post score is determined by subtracting the number of downvotes from the number of upvotes. On average, the posts received a score of 1660 ( $SD=6079.82$ ). Conceptually, the post and comment score might indicate aggregate approval of the content in the post or comment.

**Message complexity.** Message complexity was measured using the Flesch (1948) Reading Ease Scale ( $M=59.15$ ,  $SD=51.94$ ) in the *quanteda* package (Benoit et al., 2018) in R. We generated message complexity statistics where higher scores indicate that the submission was easier to read (i.e. less complex language).

**Sentiment of comments.** We used the *SentimentR* package (Rinker, 2019) in R to calculate the average sentiment of each comment. The *SentimentR* package determines the sentiment of a sentence by comparing the words in the sentence to a dictionary of words that convey positive sentiment (e.g. good, awesome, great), negative sentiment (e.g. bad, awful, poor), negators (e.g. not, can't), amplifiers (e.g. certainly), and de-amplifiers (e.g. almost). The sentence is assigned a numeric value based on the number of each type of word in the sentence.



### 3. Results

First, we examined whether there was a difference between the number of female and male scientists participating in Reddit AMAs (RQ1). Using a difference in proportions test, we found that there was a significant difference between the number of male scientists ( $n=514$ ) compared to female scientists ( $n=241$ ;  $\chi^2=97.99$ ,  $p < .01$ ) overall. While we used the entire population of posts to investigate our first research question, we narrowed our sample for the remainder of the study's investigation. It was common for scientists to participate in the Reddit AMA as a team ( $n=379$  posts). Because we were interested in how the Reddit community and scientists interacted based upon the gender of the scientists, we limited the sample to sessions where the scientist participated as an individual. After removing the posts where scientists participated in groups, we retained a sample of 269 AMA sessions. We replicated the difference in proportions test comparing the proportion of male and female scientists who participated individually and found that there was a statistical difference between the proportion of male scientists participating individually ( $n=203$ ) compared to female scientists ( $n=66$ ;  $\chi^2=68.76$ ,  $p < .001$ ). Since we were interested in conversations that happened between the scientists and members of the Reddit community, we investigated the individual comments ( $n=125,580$ ) on the subset of 269 posts.

Next, we examined whether there is a difference between the number of comments male and female scientists received on their posts (H1). We found that male scientists received significantly more comments ( $M=480.22$ ,  $SD=1265.80$ ) than female scientists ( $M=263.89$ ,  $SD=705.39$ ,  $t(302.24)=2.05$ ,  $p < .05$ ), supporting H1. We also investigated whether the number of unique redditors who contributed to the conversation varied by the scientist's gender. We did not find a significant difference based upon whether the scientist was male ( $M=247.06$ ,  $SD=741.08$ ) compared to female ( $M=128.79$ ,  $SD=379.39$ ,  $t(282.75)=1.87$ ,  $p = .06$ ), though the magnitude of the difference is substantial and approaches conventional levels of statistical significance.

Next, we examined whether the total post score varied by the scientist's gender (H2). We did not find a significant difference between the male scientist's post scores ( $M=1924.64$ ,  $SD=8234.28$ ) and female post scores ( $M=1662.33$ ,  $SD=7622.44$ ,  $t(180.85)=0.29$ ,  $p = .78$ ). Thus, H2 was not supported. H3 predicted that male scientists will receive higher scores on their individual comments than female scientists and H4 predicted that comments with complex language would receive a higher comment score than comments that did not include complex language. In order to test H3 and H4, we used two mixed-effects regression analyses presented in Table 1. In Model 1, the score a comment written by a scientist received is predicted by the gender of the scientist. In Model 2, the score a comment written by a scientist received is predicted by both the gender of the scientist and the complexity of the comment's language. In both models gender, message complexity, and comment score were modeled as fixed effects while the scientist was modeled as a random effect.

As shown in Model 1, there is not a significant relationship between the gender of the scientist and the score the comment receives ( $b=14.67$ ,  $p = .70$ ), thus H3 is not supported. In Model 2, there is not a significant relationship between the reading ease score and the score a scientist's comment receives ( $b=0.06$ ,  $p = .39$ ), therefore H4 is not supported.

Then, we examined whether there was a difference between the message complexity of the comments written by male versus female scientists. There was not a significant difference in the complexity of the comments written by female scientists ( $M=59.68$ ,  $SD=45.25$ ) as compared to male scientists ( $M=58.98$ ,  $SD=53.89$ ;  $t(6383.40)=0.73$ ,  $p = .47$ ). Thus, H5 was not supported. However, we did find that female scientists tended to write longer comments ( $M=71.54$ ,  $SD=76.17$ ) than male scientists ( $M=58.71$ ,  $SD=63.42$ ,  $t(4741.10)=8.69$ ,  $p < .001$ ). Similarly, we tested whether the relationship between the complexity of the comment and the score a comment receives

**Table 1.** Comment score as a function of scientist gender and reading ease.

	Model 1			Model 2		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
Intercept	43.89	35.30	.19	40.66	33.73	.23
Male	14.67	37.65	.70	14.68	37.64	.70
Reading ease				0.06	0.07	.39
<i>N</i>	13,448			13,443		

SE: standard error.

was moderated by gender. We did not find a significant interaction between message complexity and the gender of the scientist ( $\beta = 0.19, p = 0.32$ ), thus H5 was not supported.

Finally, we examined whether the sentiment of the comments written by redditors differed depending on if the comment was directed toward a male or female scientists. We found that female scientists received more positive comments ( $M = .075, SD = .22$ ) as compared to their male counterparts ( $M = .052, SD = .22, t(21,939) = 12.81, p < .0001$ ). Furthermore, we conducted a post hoc analysis which examined whether the sentiment of the comments written by the scientists differed based upon their gender. We found that female scientists wrote more positive comments ( $M = .11, SD = .21$ ) than their male counterparts ( $M = .10, SD = .22, t(5637.5) = 2.36, p < .05$ ).

#### 4. Discussion

This study investigated the utility of using the SNS Reddit, specifically AMA sessions, as a platform for scientists to engage with a subset of the general public. Specifically, we analyzed how female scientists communicate and are received on the platform. Investigating how female scientists were received on the site is an important endeavor given that previous research has consistently found that female scientists often experience poor treatment during online public engagement efforts.

Overall, we found that more male scientists ( $n = 514$ ) than female scientists ( $n = 241$ ) have participated in a Reddit r/IAMa session. This is unsurprising given that studies investigating the demographics of scientists participating on SNSs have found that they largely skew male (e.g. Amarasekara and Grant, 2019; Ke et al., 2017; Sugimoto et al., 2013). When investigating differences in how male and female scientists are received, we found that while male scientists tended to generate more comments (H1: supported) there was *not* a difference in either the session (H2: not supported) nor individual comment scores (H3: not supported) that male and female scientists received. The lack of a difference between the scores male and female scientists receive on their comments and posts is encouraging as it suggests that female scientists' participation in outreach activities is encouraged and accepted on the platform. This could be because the focus put on the scientist's gender is de-emphasized on the platform given that the scientist communicates through text rather than a video showing their face as is a common method on YouTube. Indeed, communicating with the public in modes which minimize the need for the scientist to show their face or record their voice is preferred for female science communicators given that it reduces the backlash they receive from members of the public (McDonald et al., 2020). Given this preference, and the evidence our study presented, Reddit AMAs could be a fruitful public engagement activity for both male and female scientists. In addition to examining how the scientist's gender influences their reception on the platform, we also investigated the role that communication style might play on how redditors rate interactions. A growing body of literature has wrestled with whether scientists

should limit their use of jargon in communication with the public. On the one hand, jargon might impede a lay person's ability to process a scientific message (Bullock et al., 2019). However, jargon might serve as an important heuristic for the scientist's credibility (Zimmermann and Jucks, 2018). As such, we predicted that scientists' comments with more complex language would receive a higher comment score than comments with less complex language. Interestingly, we found that the complexity of the message was not a significant predictor of comment score (H4: not supported). A previous analysis of comments within the overall subreddit *r/science* found that redditors prefer more complex messages (Hubner et al., 2021), which is contrary to what we found here. This points to the importance that context and audience expectations might play in acceptance of complex language. For example, when an audience member is participating in an AMA session, they might expect the scientist to explain their research in an understandable way. Yet, when an individual is seeking medical advice (Zimmermann and Jucks, 2018) or participating in an informed discussion about science (Hubner et al., 2021), they might expect experts to use technical, complex language. The motivation and expectations of the audience might moderate the relationship between complex language and individual understanding (Shulman and Bullock, 2020). More research is needed to understand under which contexts experts should use complex language and when they should translate their science in an understandable manner.

Beyond investigating the influence that message complexity has on how redditors rated the scientist's comments, we also explored whether there were gendered differences in the use of complex language. We hypothesized that female scientists might strategically use more complex language in their communications in order to bolster their credibility with their audience. Our investigation revealed that there was not a difference in the message complexity of comments written by male and female scientists. This suggests that female scientists, within their engagement activities on Reddit, are not using complex language as a strategy for being seen as an expert on their subject matter. Furthermore, we investigated whether the gender of the scientist moderated the influence of message complexity on comment score, which we did not find support for (H5: not supported). Taken together, these show that the ways in which scientists communicate with the public might not differ nor does it seem to play a role in how individuals evaluate comments from male and female scientists.

Finally, we investigated the sentiment of comments written by redditors, and whether the sentiment differed depending on whether the comments responded to a male or female scientist. Interestingly, we found that female scientists received more positive comments from redditors than male scientists. This echoes work investigating comments left on male and female science YouTube channels, where women received more positive comments than men (Amarasekara and Grant, 2019). This finding further strengthens our suggestion that Reddit AMA sessions could be a fruitful way for female scientists to engage with a large audience.


While our findings suggest that Reddit AMA sessions could be an effective platform for public engagement activities, there are some limitations that warrant discussion. First, our analyses rely on largely count metrics (number of comments, score, etc.) as well as computational content analysis techniques rather than a more nuanced qualitative analysis. While these metrics are informative for detecting overall patterns, they may mask the quality of these interactions. Our study cannot, therefore, account for whether female scientists received more hostile or sexist comments, nor can it divulge the types of questions that were asked. This limitation opens the door for future studies to conduct more nuanced analyses of the AMA sessions. Another limitation was our ability to only analyze sessions where the scientists participated individually rather than as a member of a group. Future research might wish to investigate whether the questions posed to female group members differ from the questions posed to male members. Finally, we only investigated one demographic characteristic: the gender of the scientist. It is possible that

other demographics such as age or race similarly affect participation and reception on Reddit. Further, other differences between scientists that may or may not be correlated with gender (e.g. personality style) could affect how they are received. Due to our observational research design, we were limited in which characteristics we could examine. Future work should dive deeper in order to investigate whether other demographic characteristics (e.g. age) affect how the scientist is received on the platform. Similarly, we did not investigate whether there were differences in the use of jargon dependent on the scientist's field of study. Indeed, scientists from the hard sciences might be more inclined to use complex language than those from the social sciences due to differences in training. Future research should, therefore, investigate whether there are differences in both the message complexity a scientist uses dependent on their field *and* if expectations from members of the public differ according to the scientist's specialty. Despite the aforementioned limitations, this study illustrates that Reddit is a rich platform for scientists to engage with a large number of individuals within a short period of time.

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## Notes

1. Although this investigation focuses on the reception of experts, we acknowledge that investigations of how non-experts communicate with the public is of substantial importance. However, the processes through which they communicate and are received may differ in important ways from how experts communicate and are received.
2. In some AMA sessions, more than one scientist participated (e.g. members of a lab would simultaneously answer questions).

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