Article

Women Scientists on TikTok: New Opportunities to Become Visible and Challenge Gender Stereotypes

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Abstract
Today, women scientists are still underrepresented in media coverage and confronted with gender stereotypes. However, social media might have the potential to challenge current gender stereotypes of scientists, foster diversity in science communication, and open new ways of becoming visible. We explore this potential by analyzing TikTok accounts of female scholars (n = 50 accounts). Results from content analysis (n = 150 videos) indicate that female scientists from a wide range of different disciplines and at different career stages are visible on TikTok. Building on previous research, we show that female scholars use TikTok mainly to explain scientific facts and concepts and to discuss what being a (female) scholar is like. Moreover, female scholars talk about private life events, give expert advice, and show science in the making. Finally, some of the videos analyzed address gender stereotypes by, for example, challenging assumptions on how a female professor should dress. Implications for science communication in the digital age are discussed.

Issue
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1. Introduction

"Professor Ciesek, since September you can be heard every second week alternating with Christian Drosten on the NDR podcast Coronavirus Update. Are you aware that you're the quota woman?" (Hackenbroch & von Bredow, 2020). This was the first question asked by the German Weekly *Der Spiegel* in an interview with the renowned virologist Prof. Sandra Ciesek, Director of the Department of Medical Virology at the University of Frankfurt. In the next question, Prof. Ciesek was asked how it is to be "the new one by Drosten's side," referring to her new role as expert in the podcast hosted by NDR (Norddeutscher Rundfunk; Hackenbroch & von Bredow, 2020). The podcast was launched in February 2020 with the male virologist Prof. Christian Drosten, with Prof. Sandra Ciesek joining in September 2020. Although

both virologists showed similar qualifications in their research field, the way they were interviewed by the weekly magazine notably differed. While the former was lauded as a "popstar" the latter was referred to as "the quota woman." This interview, followed by a heated debate on Twitter where users criticized the journalists for asking sexist questions, is an excellent example for illustrating the problems female scientists are still facing when appearing in their roles as scientific experts in media coverage.

Not only is it irritating and offensive for women scientists when being portrayed in a stereotypical way, this also has the potential to discourage other female scientists from stepping onto the media circuit. Indeed, women scientists are underrepresented in newspaper coverage (Aladro Vico et al., 2014; Kitzinger et al., 2008; Niemi & Pitkänen, 2017). This is also true for

portrayals of scientist characters on TV: Male scientists significantly outnumbered and appeared in many more scenes than their female counterparts (Long et al., 2010). Researchers have found that media outlets focus on female scientists' exceptional status (Chimba & Kitzinger, 2010) and are more likely to report on appearance (clothing, physical characteristics, or hairstyle, for example) when writing about female scientists than when portraying male ones (Kitzinger et al., 2008).

In recent years, scientists have begun to increasingly make use of social media (Collins et al., 2016; Jia et al., 2017; Peters et al., 2014; You, 2014; Yuan et al., 2017). Jarreau et al. (2019) argue that social media has the potential to challenge and overcome stereotypes. By using hashtags such as #womenalsoknowstuff and #distractinglysexy, women scientists have used social media as a tool of empowerment and protest (Brantner et al., 2019). Following this line of research, our study aims at exploring women scientists' visibility on social media. We focus on TikTok, a platform on the rise and one that has not yet been researched in this context. By doing so, we (a) analyze *who* becomes visible on TikTok in terms of disciplines and career stages, and (b) examine whether women scientists are using the platform to challenge current *gender stereotypes*.

2. Literature Review: Visibility and Gender Stereotypes

2.1. Visibility of Female Scholars

Women scientists are underrepresented in public discourses, as evidenced by studies investigating media coverage in so-called "western" countries such as the US or in many European nations. Kitzinger et al. (2008), for instance, analyzed science coverage in 12 UK national newspapers over a six-month period and found that male expert scientific sources are much more often cited than women; from a total of 644 quotes, 84% stem from men and only 16% from women scientists. Aladro Vico et al. (2014) found a similarly low proportion when they evaluated Spanish newspaper coverage, where only 14% of the news stories they examined focused on female scientists. A recent study from Finland indicates that public expertise continues to be male-dominated in that only 28% of all experts interviewed in the news are female (Niemi, & Pitkänen, 2017). Similar patterns can be observed when it comes to television output: A content analysis of German TV programs revealed that 79% of experts were male (Prommer & Linke, 2019), and a study investigating Israeli talk shows found that 63% of the featured experts were male (Hetsroni & Lowenstein, 2014). When looking specifically at *scientific* experts on TV, the figures are even more striking—out of all the scientific experts visible on German TV news, 81.5% were male (Nölleke, 2013).

The underrepresentation of female scientists in the media has been deemed problematic from three perspectives (Crettaz von Roten, 2011): (a) From a career perspective, because public outreach is becoming increasingly important for scientific careers; (b) from a democracy-oriented perspective, a more diverse picture of scientific experts in the media would improve the quality of the discourse; (c) from an educational perspective, a greater visibility of female scientists in the public sphere allows more role models to be seen by young people—"If young people do not see women articulating science, the impression will be that women don't do science" (Manaster, 2013). Following this line of argument, it is vital that female scholars from different disciplines become visible. TikTok—as a platform targeted mainly at young people—might have a key role to play here. Accordingly, we are interested in exploring which female scholars become visible on TikTok, and pose the following research question:

RQ1: Which female scholars are visible on TikTok in terms of disciplines (RQ1a) and career stages (RQ1b)?

2.2. Visibility of Topics

Visibility on social media has the potential to increase diversity in science communication because scientists are free to choose how they want to present themselves and what to talk about (Metag, 2021). Scientists develop different strategies for shaping their discourse practices in digital communication environments (Koivumäki et al., 2020), and emotional appeals and "edutainment"-oriented approaches in science communication are seen as having the potential to enable communicators to reach new audiences (Taddicken & Reif, 2020). Zawacki et al. (2022) argue that TikTok may function as a platform where educational science videos are able to reach a large audience without much effort. Habibi and Salim (2021) found that short lecture-style videos on TikTok had a significantly higher "watch time" compared to longer lecture-style or experimental videos. When it comes to the topics scientists talk about on social media, the boundaries between work and private life are blurring since many scientists use social media accounts for sharing both personal and professional information (Bowman, 2015). Zhang and Lu (2022) argue that scientists engage in two types of content—related self-disclosure on social media: professional self-disclosure ("the sharing of professional experiences and research related to a scientist's career," p. 3) and personal self-disclosure ("the sharing of personal interests, hobbies, and other non-science-related information," p. 3); they also point out that it matters which topics scientists decide to talk about on social media. More specifically, scientists tend to be rated as more likable when they share personal information but also as less competent. Conversely, when scientists disclose professional information, they are perceived as more competent and also as more engaging. Recent research suggests that, on TikTok as well, scientists tend to communicate both professional as well as personal information (Zeng et al., 2021).

TikTok is one of the fastest-growing social media platforms, with more than a billion users worldwide (TikTok Newsroom, 2021). TikTok has been headline news several times due to its dance routines (Page, 2020) or because of privacy concerns (Ovide, 2020). However, it is only now that the platform has started to receive scholarly attention in the field of communication studies (Hautea et al., 2021; Vázquez-Herrero et al., 2020; Zeng et al., 2021). There is hence a need to explore TikTok as a new channel for science communication. TikTok has specific features—such as a short format, community-building tools, and a so-called "duet function"—that seem to encourage a particular kind of science-oriented communication: highly visual, vernacular, and meme-friendly (Zeng et al., 2021). TikTok features such as searching, meta-voicing, livestreaming, and recommending are designed to impact users' experiences (Song et al., 2021), and creators on the platform experiment with these features by mixing, blending, and subverting content (Literat & Kligler-Vilenchik, 2019). TikTok's users are "algorithmically, digitally, and socially encouraged to consume content conducive for imitation and for the purpose of imitation" (Zulli & Zulli, 2022, p. 1884). Schellewald (2021) adds that TikTok creators use a range of communicative tropes and formats such as comedy, documentary, videos co-created with partners, family, and friends, challenges by means of the duet function, tutorials, and "life hacks." Platform characteristics like visibility, editability, and association make TikTok an especially fascinating case for research into science communication (Hautea et al., 2021).

At the same time, social media is also a space where women face hostility and misogyny (e.g., Alvares, 2018; Chen et al., 2020; Gardiner, 2018; Ging & Siapera, 2018; Han, 2018; Henry & Powell, 2016; Mantilla, 2013; Marwick & Caplan, 2018; Simões & Silveirinha, 2019). This is also the case for female scholars (Veletsianos et al., 2018; Vera-Gray, 2017). Online harassment of women has been discussed as a way of excluding women's voices from the digital public sphere (Megarry, 2014), or silencing their voices on certain topics. In one interview-based study, for example, Carter Olson and LaPoe (2018) found that "women and minority academics' fear of harassment online leads to self-censorship, creating a digital spiral of silence" (p. 271). Indeed, research has pointed to a notable gender gap in terms of the visibility of bloggers (Harp & Tremayne, 2006; Meraz, 2008; Pederson & Macafee, 2007). Similarly, researchers have also identified a gender imbalance when it comes to content providers on YouTube (Döring & Mohseni, 2018; Khan, 2017; Tucker-McLaughlin, 2013; Welbourne & Grant, 2016). Amarasekara and Grant (2019) analyzed science communication accounts on YouTube and found that only 32 of the 391 most popular YouTube channels focusing on STEM (science, technology, engineering, and mathematics) subjects were hosted by women. These accounts were found to garner noticeably more hostile, negative, and sexist comments than accounts hosted by

men. Döring and Mohseni (2020) observed that female YouTubers received more sexist, racist, and sexually aggressive hate comments. To sum up, "Online spaces remain a double-edged sword for women, not only providing opportunities for self-expression but also making them vulnerable to abuse" (Eckert, 2018, p. 1284). Duffy and Hund (2019, p. 4983) refer to the "vexed nature of visibility" on social media. In line with this argument, TikTok can be conceptualized as an ambiguous digital space for women scientists. What Thompson (2005) formulated for political actors might also be true for scientists; they might be "more closely scrutinized than they ever were in the past; and at the same time, they are more exposed to the risk that their actions…may be disclosed in ways that conflict with the images they wish to project" (p. 42). Given this ambiguity inherent in the nature of social media as a digital space with silencing strategies like hostility and misogyny, but also acknowledging its potential for enabling and empowering, a key research focus here is on how women scientists express themselves in terms of what topics they talk about:

RQ2: Which *topics* do female scholars talk about in the TikTok videos analyzed for this study?

2.3. Gender Stereotypes

Alongside the underrepresentation of women scientists in media coverage, stereotypical portrayals of women scientists in the media are increasingly being seen as problematic. In the field of psychology, gender stereotypes come in many shapes and forms (for an overview, see Cejka & Eagly, 1999; Deaux & Lewis, 1984; Diekman & Eagly, 2000; Schneider & Bos, 2014): physical stereotypes, cognitive stereotypes, and stereotypes related to personality. While for men, physical stereotypes include attributes such as muscular, physically strong, and burly, those for women are cute, gorgeous, and beautiful. When it comes to cognitive stereotypes, men tend to be characterized as good with numbers, analytical, good at problem-solving, or quantitatively skilled. Cognitive stereotypes for women are imaginative, intuitive, artistic, and creative. For women, "positive" stereotypes relating to personality include affectionate, sympathetic, gentle, and sensitive, and those for men are competitive, daring, adventurous, and aggressive. "Negative" personality traits for women include spineless, gullible, servile, subordinating self to others, whiny, complaining, nagging, and fussy, while those for men include egotistical, hostile, cynical, arrogant, boastful, greedy, dictatorial, and unprincipled. Ellemers (2018) argues that, whereas stereotypes in general and gender stereotypes in particular may be helpful when someone is evaluating certain perceived properties of large groups, they are ill-suited to assess the characteristics of individuals:

Gender stereotypes exaggerate the perceived implications of categorizing people by their gender and

offer an oversimplified view of reality. They reinforce perceived boundaries between women and men and seemingly justify the symbolic and social implications of gender for role differentiation and social inequality. The broad awareness of gender stereotypes has far-reaching implications for those who rely on stereotypical expectations to evaluate others, as well as those who are exposed to these judgments. (p. 278)

In the literature, stereotypes have often been discussed in relation to the roles that women and men are expected to play in "society." Hentschel et al. (2019) argue that "the persistence of traditional gender stereotypes is fueled by skewed gender distribution into social roles" (p. 3). When it comes to stereotypes for scientists, research using the "Stereotype Content Model" (Fiske et al., 2002) is relevant. This model presupposes that stereotypes are ascribed along two dimensions: perceived warmth and competence. "Traditional" women are, for instance, stereotypically perceived as warm but incompetent, and "professional" women as competent but cold (Fiske, 2010). Fiske and Dupree (2014) asked an American online sample of adults to rate warmth and competence in terms of how the respondents believed these applied to people working in particular jobs (from a list of 42 occupations). Results show that while some jobs such as nurses, teachers, or doctors were rated as being warm, trustworthy, capable, and competent (high-warmth, high-competence profession), scientists and researchers earned respect but were not necessarily trusted (high-competence, low-warmth profession). Respondents reported feeling sentiments of envy and jealousy toward people in this group, which also included lawyers, managers, engineers, and accountants. Interestingly, professors or teachers were perceived as generally "warmer" people than scientists or researchers.

Media outlets in many western countries tend to present male scientists more often as protagonists and women as a visual resource (González et al., 2017), are more likely to report on appearance (clothing, physical characteristics, or hairstyle) when writing about female scientists than when portraying male scientists (Kitzinger et al., 2008), and tend to focus on female scientists' exceptional status (Chimba & Kitzinger, 2010). Mitchell and McKinnon (2019) analyzed the profiles of scientists published in *The New York Times* and found that profiles of female scholars were more likely to mention relationship status (92% for females, 63% for males) and parenthood status (67% for females, 32% for males). Cheryan et al. (2013) suggest in their experimental study that stereotypical portrayals of scientists negatively affect young women's interest in the discipline portrayed. More specifically, college students at two US universities read newspaper articles about computer scientists that depicted the latter either as fitting the current stereotypes or no longer fitting these stereotypes. Female students who read that computer scientists no longer fit the stereotypes showed higher levels of interest in computer science than female students who read the version of the article where computer scientists continued to fit the stereotyped portrayal. Hence, overcoming stereotypes seems to be a crucial step in fostering young women's interest in science.

Research indicates that social media can be both a space where gender stereotypes are reproduced as well as one where they can be challenged. While Bailey et al. (2013) argued that young women perceive social media as a "commoditized environment in which stereotypical kinds of self-exposure by girls are markers of social success and popularity" (p. 91), they also identified initiatives to counter gender stereotyping. Referring to viral hashtags such as #distractinglysexy, Morrison (2019, p. 23) speaks of an "emerging mode of online resistance" where social media is used to gain wide-ranging visibility, hashtags for grass-roots collective action are created, content is spread virally, and humor is deployed to destabilize the institutionalized images painted by dominant groups. Brantner et al. (2019) resume that by using "unstereotypical self-stereotyping," women scientists created networked counter-publics on social media that also managed to get wide attention in traditional media discourses. So, while some users may still be conforming to (apparent) norms and disseminating stereotypes and clichés when they interact in digital spaces, counter-discourses are also springing up (Wilhelm, 2021). Building on this line of research, we are interested in exploring whether women scientists are using TikTok to challenge gender stereotyping:

RQ3: To what extent do female scholars in the TikTok videos analyzed here counter or challenge current gender stereotypes?

3. Methods

3.1. Sample

To answer our research questions, we analyzed accounts of female scholars on TikTok. We applied two strategies to identify relevant accounts: (a) we searched by using hashtags such as #academia, #academicsoftiktok, #academictiktok, #phd, #phdlife, #phdstudent, #postdoc, #professor, #professoroftiktok, #research, #scicomm, #science, #sciencetiktok, #scientist, #socialscience, #womeninscience, #womeninstem, etc.—we started by using these hashtags and added relevant additional hashtags we encountered during our search; (b) we followed links on these accounts to other accounts. In order to be able to code the videos ourselves, we only selected English- or German-speaking accounts.

All accounts where it became obvious that women were currently involved in science were included. Having a current university affiliation was not necessary for being included in our sample (for instance, not all PhD students are employed at a university). People who

had completed a university degree and moved to a different sector afterwards were excluded (e.g., coaches). We were able to identify 113 accounts. After excluding 12 accounts whose protagonists did not create their own videos, had a private account, or were no longer working in academia or in some other type of research institute, our list ended up with 101 accounts. We sorted the accounts according to the number of followers and selected the top 50 accounts (see Table 1). In the next step, we selected the three most viewed videos from the most recently posted 12 videos (the number of videos that could be viewed at a glance on the screen) on each account, which resulted in the final sample (n = 150 videos).

3.2. Measurement

We developed a coding scheme consisting of 20 categories. The coding scheme included formal categories (ID, coder name, account name, number of followers, number of videos, number of likes, number of views, etc.) and content-related categories (e.g., scientific discipline, career stage, topic, gender stereotypes).

We used two categories to code the discipline of TikTok creators: (a) An open category in order to classify the specific discipline (e.g., psychology, biology, chemistry), and (b) a closed category. For the closed category, we coded whether the discipline belonged to natural sciences or social sciences and humanities. Similarly, for capturing the career stage of female scholars, we used (a) an open category where we included the current position held by the person who created the posted content, and (b) a closed category where we assigned it to one of three levels of educational attainment (or career stage), namely—(a) PhD, comprising all creators who were currently doing their PhD or who had completed it, (b) professor or assistant professor, or (c) others. While some scholars indicated this information on their TikTok account, for others it was available when following the link tree on TikTok, and for some we consulted their professional website. Building on prior research (Zeng et al., 2021), we coded the topic of the video according to the following scheme: (a) Science in the making—videos showing experiments being done or do-it-yourself (DIY) activities in the name of science; (b) facts, concepts, phenomena explained—videos of someone presenting facts or explaining a science phenomenon; (c) expert advice/opinion—whereas the previous category comprises videos that featured scientists explaining something, this code was assigned when the content seemed to go beyond explaining something in the form of advice to the public or giving advice from a position of expertise; (d) being science students/teachers/scientists—videos showing the "behind the scenes" life of a science teacher or researcher—for example, videos of science students in school reflecting on their experience of studying science; (e) private life—family, friends, personal stories, personal (not job-related) problems and hobbies;

(f) others—for all content that did not fit the other five classifications of content. In addition, we used an open category where we summarized the content of the video in our own words. When a TikTok creator talked about gender stereotypes an open category was used to capture the content in detail. In addition, a closed category was used to code whether this was the case (yes or no).

To assess inter-coder reliability, two coders coded the same 10% of material. Reliability between the two coders was calculated using Cohen's kappa. All formal categories reached perfect agreement (Cohen's kappa = 1). For the topic category, Cohens's kappa was moderate (.39), and for gender stereotype it was fair (.29). Given that this was an exploratory study and the first one to apply and expand on the categories recently developed by Zeng et al. (2021), lower coefficients are acceptable (Lombard et al., 2002).

3.3. Ethical Considerations

When analyzing content that is publicly available online for research purposes, some ethical challenges arise. Following the argument of Sugiura et al. (2017), getting informed consent is not a realistic option; rather the focus should be on guaranteeing anonymity and minimizing potential risks for the subjects of this investigation. Fortunately, most TikTok accounts investigated in this study used pseudonyms rather than real names. Hence, the risks that our study might damage TikTok creators were kept to a minimum.

4. Results

First, we were interested in seeing which female scholars are visible on TikTok in terms of discipline and career stage (RQ1). When looking at the 50 accounts selected for this study, results show that female scholars from a wide range of different disciplines and career stages are visible on TikTok (see Table 1). However, when assigning the disciplines to natural sciences vs. social sciences and humanities, the former is clearly dominant. Table 2 shows that 80% of the analyzed accounts stem from people working in the natural sciences. We also coded the different career stages of TikTok creators into three levels. Most of them (64%) are currently doing their PhD or had recently completed one. However, professors are also visible in the analyzed TikTok videos—every fourth account in our sample had been created by a professor or assistant professor.

Next, we examined which topics women scientists talk about on TikTok (RQ2). To address this, we examined the topics of the three most viewed videos on each of the 50 accounts (n = 150). Basing our typology on categories developed by Zeng et al. (2021), we distinguished between five different types of content. The results in Table 3 show that in nearly a third of the videos, female scholars explained facts and concepts. Female scholars also talked about what it was

Table 1. Sample: Selected accounts of women scientists on TikTok.

ID	Career Stage	Discipline	Number of Followers	Number of videos	First video
1	Professor	Psychology	738,000	681	2021–06–02
2	Astronaut candidate	Bioastronautics	357,700	172	2020–05–24
3	PhD	Neuroscience	240,800	668	2021–03–23
4	Professor (retired)	Microbiology	216,000	128	2020–11–26
5	Assistant professor	Bioengineering	211,300	105	2020–10–05
6	Professor	Educational Leadership	208,400	493	2020–04–19
7	PhD	Biology	143,200	86	2020–05–26
8	PhD	Molecular Biology	114,800	254	2019–10–01
9	Assistant professor	Epidemiology	100,300	275	2020–08–01
10	Researcher	Neuroscience	98,600	206	2020–04–22
11	PhD	Biology	92,200	28	2020–03–19
12	PhD	Astrophysics	87,200	731	2020–01–20
13	PhD	Neuroscience	85,300	243	2020–03–25
14	PhD	Earthquake Engineering	85,100	158	2020–03–19
15	Researcher	Chemistry	76,200	26	2018–04–30
16	PhD	Physics	65,100	25	2021–01–19
17	PhD	Genetics	61,800	127	2020–06–25
18	Assistant professor	Psychology	52,400	187	2020–03–30
19	PhD	Psychology	48,300	132	—
20	PhD	Biochemistry	45,700	224	2019–09–06
21	PhD	Molecular Ecology	44,000	155	—
22	PhD	Communication Studies	41,700	36	2020–04–10
23	PhD	Biology	41,500	59	2020–12–28
24	PhD	Molecular Science	36,600	53	2020–03–24
25	PhD	Neuroscience	35,200	91	2020–01–31
26	PhD	Biology	33,800	19	2020–10–29
27	Professor	Cell Biology	31,000	540	—
28	PhD	Psychology	30,100	51	2020–03–15
29	Researcher	Anthropology	27,800	160	2019–01–18
30	Visiting professor	Engineering	23,500	344	2019–11–10
31	Assistant professor	Information Science	21,600	219	2020–11–11
32	PhD	Astrophysics	21,200	183	2019–12–07
33	PhD	Astrophysics	20,400	97	2019–11–18
34	PhD	Aerospace	18,300	125	2020–03–19
35	PhD	Biology	16,600	96	2020–01–7
36	PhD	Biology	16,000	135	2019–05–14
37	PhD	Plant Pathology	14,500	296	2019–06–24
38	Associate lecturer	Education	13,800	18	2020–04–17
39	PhD	Planetary Sciences	13,600	81	2020–10–20
40	Instructor	Mathematics	11,800	206	2020–05–03
41	PhD	Biology	9,630	136	2020–11–28
42	PhD	Astrophysics	8,336	17	2020–03–07
43	Professor	Political Sciences	7,465	366	2020–04–08
44	PhD	Medicine	7,387	136	—
45	PhD	Astrophysics	6,414	209	2020–10–05
46	Assistant professor	Gender Studies	5,770	911	2019–02–15
47	PhD	Marine Science	5,065	216	2019–10–31
48	Professor	Chemistry	4,863	37	2020–11–14
49	PhD	Microbiology	4,344	80	2020–02–14
50	PhD	Neuroscience	3,766	57	2019–12–21

Notes: Number of followers and number of videos were retrieved from the accounts between October and December 2020. The dates of the first video posted for each account were added in December 2022; four accounts were no longer active at that time, and these are indicated by —.

Table 2. Academic discipline and career stage of the female scholars on TikTok studied.

	n	%
Discipline		
Natural sciences	40	80
Social sciences and humanities	10	20
Career Stage		
PhD	32	64
Professor/assistant professor	13	26
Others	5	10
Total	50	100

Table 3. Topics of the TikTok videos analyzed.

Topics	*n*	%
Facts, concepts, and phenomena explained	44	29
Being science students/teachers/scientists	43	29
Private life	22	15
Expert advice/opinion	20	13
Science in the making	16	11
Others	5	3
Total	150	100

Note: Categorization based on categories devised by Zeng et al. (2021).

like for them being a scientist—that is, videos showing the "behind the scenes" life of being a PhD student or a professor or reflecting on academia—which applied to 29% of the videos. The third most common topic was private life. These videos dealt with hobbies and activities, family, relationships, etc. The videos from the next category—giving expert advice—often dealt with vaccinating against Covid-19. Finally, some videos also showed "science in the making" (for instance, lab experiments).

Finally, we investigated to what extent women scientists on TikTok counter or challenge current gender stereotypes (RQ3). Results reveal that 11% of the 150 videos analyzed made reference to gender stereotyping. In the following, we present three examples to illustrate the ways this happened: The first example relates to physical appearance. In this video, a professor talks about a common stereotype—being judged by physical appearance and clothing. She responds to users who criticized how she was dressed. In the video, she wears different band shirts, and the text in the video says: "Common insults from trolls is that I'm 'unprofessional for a doctor.' I work at a university, I'm a PhD, & tiktok isn't my office." She challenges the stereotype that female scientists need to be dressed in a certain way in order to be credible and professional. The second example is about role expectations and role conflicts. In the video, a molecular scientist works out on a treadmill and captions appear that indicate her different roles: molecular scientist, educator, rapper, PhD, model. We first see her wearing a large coat. Next, she appears wearing a

crop top and miniskirt. She is challenging stereotypes by claiming that different roles do not need to exclude one another: "I do it all." The third example relates to stereotypes that females in tech encounter. An assistant professor of information science picks up on a TikTok trend to call out stereotypical thinking in different fields. The following texts appear: "Now this is going to be a bit technical," "could someone else weigh in on this?," "oh could you take meeting notes?," "I don't know how you balance this job with family," and "you must be in marketing." She concludes: "Things much more rarely said to men in the tech industry."

5. Conclusions

This study aimed to explore TikTok as a platform for science communication. More specifically, we were interested in investigating how female scholars use TikTok. This study focused on assessing *who* becomes visible on TikTok in terms of disciplines and career stages, which *topics* are addressed, and whether the platform is also used to *counter stereotypes*. Results from an exploratory content analysis of selected TikTok accounts suggest that natural sciences are dominant on the platform. When looking at creators' level of educational attainment, or career stage, PhD students are the most active on TikTok. This might have to do with their age which comes closer to the target group of the platform. It might also be that scholars at this career level see the value in making themselves visible on different platforms to improve their chances of employment or tenure

by, for example, connecting with potential colleagues in their research field, or by becoming involved in public debates. However, professors also use TikTok to gain visibility. In our sample, for instance, the account of a retired professor was the fourth most watched and followed. This finding points to the need to examine the use of social media platforms by older people in more detail (Nguyen et al., 2022). Our study also generated insights into the topics female scholars address on TikTok. By analyzing the three most viewed videos on each of the selected accounts (*n* = 150 videos), our findings suggest that female scholars use TikTok mainly to explain facts and concepts and to talk about their experiences of being a (female) scientist which entails reflecting on what goes wrong in academia. This finding is in line with Schellewald's (2021) argument that TikTok is a space where users can also take meta-perspectives. Moreover, female scholars talk about their private lives, show science in the making, and give expert advice. Some of the videos that belong to the latter category also dealt with Covid-19 vaccines and debunked disinformation. Accordingly, future studies need to investigate science-related disinformation on TikTok as well as what motivates people to counter the distortions of some user-generated content (Basch et al., 2020; Wintterlin et al., 2021). In our sample, some female scholars used TikTok to counter stereotypes they faced in their jobs and areas of research or had encountered in their everyday social lives. Future research could explore the effects of movements similar to #womenalsoknowstuff or #distractinglysexy (Brantner et al., 2019) on TikTok. Similarly, a promising line of inquiry could also be to investigate whether or not career stage influences people's willingness to challenge stereotypical thinking on TikTok.

This study does not come without limitations. One limitation concerns our sample. Because we identified accounts of women scientists on TikTok by using hashtags, female scholars who did not use these hashtags were not part of our sample. We encountered a lot of hashtags related to natural sciences during our search, which might have biased the sample. Similarly, female scholars communicating in a language other than English or German were not included in the sample, which represents another limitation of this study. Hence, future research into TikTok accounts of female scholars who use other languages—which would entail inputting different search terms—are needed so that people can explore female science communication on the basis of a larger sample of science communicators. It will also be advisable to look at different cultural contexts; because most creators did not share their location, we were unable to take this variable into account. In addition, it would be useful to determine the percentage of male vs. female scientists presenting themselves and their work on TikTok in order to ascertain whether or not the platform indeed contributes to overcoming the underrepresentation of female scholars in public discourses. Moreover, a more nuanced analysis of stereotypes is needed since our attempt to investigate these by using a quantitative approach was limited, and this is reflected in relatively low reliability. Here, an in-depth qualitative analysis would be a better-suited approach. Additionally, when creators talk about having different roles and point out that these roles do not need to be mutually exclusive, this might convey different messages: while some followers might interpret this as an empowering message that women scientists *can* "do it all," others might feel pressured by the idea that women scientists *need* to do it all and to be successful in different roles. Hence, research is needed to explore the effects of such messaging. It is important to note that social media can be both—an empowering tool for women scientists as well as a space of hostility and misogyny: "Scientists must navigate the tension of creating visibility for themselves and their work more easily through online communication and the potential dangers of online visibility (e.g., reputational harm, misuse of scientific knowledge, and public criticism or even hostility)" (Metag, 2021, p. 138). Examining this viewpoint by means of content analysis is a challenge considering that one common strategy to deal with hate comments is to delete them (Eckert, 2018). A fruitful approach to investigating TikTok as a space that enables hostility and misogyny would involve carrying out interviews with the TikTok account owners we came across in our work for this article. Another question that deserves attention is: How do young women thinking about becoming researchers react to hostile and misogynistic comments directed at female scientists on TikTok and other platforms? Might the visibility of female scholars on such occasions also have negative implications by, for example, dissuading young women from pursuing a career in science? In this context, we should also look at what social media platforms and governments can do, not only to increase the visibility of women (and women scientists) on social media but also to make online spaces less hostile and more inclusive (Wilhelm, 2021). Finally, future studies should explore (new) science audiences on TikTok by, for example, investigating to what extent different science communication audience segments (Klinger et al., 2022) can be reached and engaged by (female) scientists on TikTok.

Despite these limitations, this study was able to offer initial insights into the science communication of female scholars on TikTok. Findings from this study suggest that this platform might (at least to some extent) be a tool that allows and empowers female scholars to present themselves according to their own self-definitions, raise awareness for important topics, and draw attention to and talk about current stereotypes.

Conflict of Interests

The authors declare no conflict of interests.

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