



ARTICLE

Framing science on social media: strategic science communication practices of women astronaut science influencers on Instagram

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Abstract

Strategic science communication is an essential tool for scientists and other science communicators seeking to engage audiences with science on social media. Recent research has focused primarily on strategic science communication training to help scientists create messages to achieve specific audience outcomes in traditional media contexts, and less research has considered its application for social media content creation. Guided by the communication process theory of framing that highlights the essential link between communicators and audiences, this study assesses framing of strategic science communication in practice on social media by examining the topics or issues selected, message frames created, and communication tactics presented in 194 publicly available Instagram posts shared by three prominent women astronaut science influencers (SIs). Findings identified six topics or issues, seven message frames, and five communication tactics, suggesting use of framing as strategic social media science communication to advance audience-centred goals and objectives and build a unique personal brand to engage diverse audiences. Findings have practical implications for strategic social media science communication training and practice and for promoting public engagement in science.

Keywords

Women in science; Science and media; Popularization of science and technology

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With 5.4 billion users worldwide as of 2025 [Statista, 2025], social media are powerful tools for reaching large audiences through science communication [Hwong et al., 2017]. Strategic science communication — an intentional articulation of audience-centred communication goals and objectives aligned with specific tactics — has been identified as crucial for advancing public engagement with science [Besley & Dudo, 2022]. The communication process theory of framing [Scheufele, 1999; Scheufele & Iyengar, 2017] highlights the value of strategic communication, noting how communicators' purposeful selection, creation, and presentation of messages shape audiences' interpretations to achieve effective communication. However, prior research on strategic science communication has focused primarily on scientists' willingness, prioritization, and intentions to communicate through traditional media channels such as newspapers and television [Besley et al., 2018, 2019, 2021; Dudo & Besley, 2016]. Less research has considered strategic science communication practice on social media [Yeo, 2022; Yuan et al., 2022]. Drawing on the communication process theory of framing, this study uses reflexive thematic analysis [Braun & Clarke, 2021] to examine strategic science communication message creation practices on Instagram by a highly visible group of women astronaut science influencers (SIs).

In June 2024, Virgin Galactic, a publicly traded spaceflight company, announced a collaboration with the International Institute for Astronautical Sciences (IIAS) for an upcoming spaceflight led by an all-women, international crew to continue research on fluid in microgravity [Howell, 2024]. Kellie Gerardi, a U.S. bioastronautics researcher, leads the crew as director of human spaceflight operations [Virgin Galactic, 2024]. Dr. Norah Patten, an Irish aeronautical engineer, serves as a bioastronautics researcher [Virgin Galactic, 2024]. Dr. Shawna Pandya, a Canadian physician, aquanaut, and bioastronautics researcher, is the space medicine group director [Virgin Galactic, 2024]. Each of these women astronauts has a personal social media presence, acting as scientist, educator, and influencer, affording opportunities to reach large audiences through science communication. These SIs are especially active on Instagram, a visually rich social media platform that integrates static photos and short-form videos, widely used by women, college educated, higher socioeconomic level, and urban or suburban U.S. users [Lama et al., 2025]. Often posting daily or weekly, collectively, they reach over 1.5 million followers: Gerardi has 1.4 million followers [Gerardi, n.d.], Patten has 99,000 followers [Patten, n.d.], and Pandya has 30,000 [Pandya, n.d.].

The potential reach of Instagram posts shared by these prominent astronaut women SIs is significant. Space exploration is currently led by private companies, rather than governments [Holmes, 2024], bringing renewed public interest in space exploration. Moreover, space travel has dominated recent news headlines, with widespread national and international publicity about the 2026 Virgin Galactic spaceflight, in particular. Women in STEMM (science, technology, engineering, mathematics, medicine) influencers and content creators have been highly visible in social media contexts, using platforms such as Instagram to amplify issues related to gender disparities in STEMM, reshape stereotypes about women in STEMM, support underrepresented groups in STEMM, and encourage younger generations to pursue STEMM careers [Huber & Baena, 2023; Steinke, Baumel & Turner, 2024; Steinke, Coletti & Gilbert, 2024; Suk et al., 2026; Wells, 2022]. Current public interest in new space ventures [McNamee, 2025; OECD, 2019] as well as the visibility of these SIs guided our selection of women astronaut SIs for this study and provided a unique opportunity to study framing as strategic science communication on social media.

Framing has been used to describe the selection, creation, and presentation of information in communication messages. Entman [1993] focused primarily on the *selection* of information, describing framing as a process used to “select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation” [Entman, 1993, p. 52] and highlight “bits of information” [Entman, 1993, p. 53]. In the communication process model of framing, Scheufele [1999] focused primarily on the *creation* and *presentation* of information, distinguishing between media frames created by communicator and audience frames conceived by audiences when processing and interpreting messages. This perspective stressed the importance of communicators’ consideration of how to create and present information (i.e., structure, content, tone, emphasis) when seeking to influence the ways in which audiences interpret information. According to this model, careful consideration of content construction is crucial for fostering shared meaning between communicator and audiences. Adapting these perspectives, we define framing as communicators’ intentional selection, creation, and presentation of media content to focus audiences’ attention on *what to think about* [Entman, 1993], *how to think about it* [Entman, 1993; Nisbet & Mooney, 2007; Scheufele, 1999], and *where to direct their attention* [Scheufele, 1999]. This study systematically examines women astronaut SIs’ framing as the purposeful and intentional selection of topics or issues, creation of message frames, and presentation of communication tactics. Findings seek to (1) advance understanding of strategic science communication practices on social media and (2) build on emerging scholarship on message framing and engagement strategies used by women SIs on social media. This study has theoretical and pragmatic implications for science communicators seeking to engage social media audiences.

1 - Literature review

1.1 ■ Framing and strategic science communication

Conceptualizations of “frames” have varied widely by and within research disciplines [Cacciatore et al., 2016; Entman, 1993; Gamson et al., 1992; Goffman, 1974; Scheufele, 1999] and have been criticized for being fragmented and lacking specificity [Entman, 1993; see van Dijk, 2023 for concept origin and review]. In media studies, definitions of frames have focused on the communicative aspects of the linguistic elements and structure of messages. Subsequently, studies informed by this perspective have focused on deliberate tactics communicators use to call audiences’ attention to or downplay certain elements of issues [Kreuter & McClure, 2004]. Some of these tactics include the use of language, such as “metaphors, catchphrases, visual images, moral appeals, and other symbolic devices” [Gamson & Modigliani, 1989, p. 2] or syntax, script, theme, and rhetoric [Pan & Kosicki, 1993]. Media studies of framing have examined text [Culver & McLeod, 2023; Detenber et al., 2018] and visuals in traditional print media [Joubert & Wasserman, 2020], text and visuals in digital media [Nigg et al., 2025], as well as discourse on social media [Gonzalez et al., 2024; Mörner & Olausson, 2017].

Extending earlier conceptualizations of media framing, Scheufele [1999] outlined the process theory of framing of media effects that links frame building, frame setting, and individual-level framing processes. This approach also later highlighted the importance of non-verbal, visual frames and their effects [Scheufele & Iyengar, 2017]. The connection

between communicators and the frames that they create and present (media or message frames) and the audiences and the frames that they conceive when interpreting messages (audience or individual frames) is crucial. Alignment of communicator frames and audience frames is central to effective communication. To successfully engage and influence audiences, communicators must carefully and purposefully construct media content, crafting content in ways consistent with how they perceive people understand the world and incorporating people's "pre-existing collective identities, worldviews, or other ideologies" [Kreuter & McClure, 2004, p. 282]. However, it is important for communicators to recognize that even despite their best efforts to direct and guide audience interpretation, audiences are likely to derive multiple interpretations from the same message because of audience variability [van Dijk, 2023]. Failing to recognize the multiplicity of possible audience frames or multiple possible interpretations has been an important criticism of framing analysis in media research [van Dijk, 2023].

Two recent definitions of framing are particularly useful for examining framing of social media content because they highlight the importance of actions taken by the communicator in considering how framing content might influence diverse audiences differently during the communication process. *Communicative framing* defines framing as the creation and selection of all communication factors that determine how a cognitive frame is communicated [Sullivan, 2023]. *Strategic framing* defines framing as intentional communication that seeks to gain public attention, draw attention to certain topics and problems, and persuade audiences [Guenther et al., 2020]. Both perspectives advance audience-centric views of framing.

Drawing on these perspectives, we conceptualize framing of science communication on social media as purposeful and intentional (i.e., strategic) communication constructed to align media frames with audience frames to achieve shared meaning. We view framing as an essential component of strategic social media science communication that involves the selection of topics or issues, creation of message frames, and presentation of communication tactics not only to highlight the salience of media messages for audiences (e.g., what to think about) but also to influence their ways of thinking (e.g., how to think about it, and where to focus their attention). Strategic framing can be a useful tool for promoting science engagement to achieve a wide array of strategic science communication goals [e.g., alter perceptions, change behaviours, and encourage acceptance; Besley & Dudo, 2022].

1.2 ■ *Women science influencers as strategic science communicators*

Social media have opened doors to women in STEMM, providing new opportunities to present information about science, share their experiences as astronauts, and shape public discourse about women and science [Huber & Baena, 2023; Steinke, Coletti & Gilbert, 2024; Steinke, Gilbert et al., 2024; Suk et al., 2026; Wells, 2022; Yoong & Wong, 2025]. Prior research has examined women SIs' and content creators' self-presentation, role modelling, advocacy efforts, and visual-space making on a variety of social media platforms [Huber & Baena, 2023; Steinke, Coletti & Gilbert, 2024; Steinke, Gilbert et al., 2024; Suk et al., 2026; Wells, 2022]. However, research has just begun to explore their message framing and engagement strategies [Suk et al., 2026; Spang & Steinke, 2026]. An important aspect of social media influencers' online presence is the ongoing reciprocity between their impact and audience feedback [Carpenter et al., 2023], suggesting optimal conditions for science engagement.

Women SIs belong to a larger conglomerate of social media influencers, individuals with large social media followings who have built a personal brand and embraced opportunities for monetizing brand deals [Carpenter et al., 2023]. Influencers have gained tremendous visibility in algorithmically driven platforms and earned large audiences [Arriagada & Ibáñez, 2020], suggesting opportunities for science communicators to strategically leverage social media to advance their goals and objectives and broaden their public reach [Zhang & Lu, 2026]. To increase their number of followers and build diverse audiences, women SIs strategically utilize platform affordances (e.g., hashtags, videos) to capitalize on social media trends (e.g., selfies, trending sounds) or connect with audiences (e.g., “day in the life” posts) in ways that promote personal connections online [Suk et al., 2026] and are likely to lead to greater engagement with and understanding of scientific material [Coletti et al., 2022; Bainotti, 2024]. Social media provide opportunities for women SIs, to strategically frame their content in deliberate, audience-centric ways to attract and influence their audiences.

For women SIs, like those on the Virgin Galactic spaceflight team, social media provide opportunities to achieve specific science communication goals as they build large, diverse audiences. Thus, for this study, we consider the communication by these women astronaut SIs as strategic, focusing on how they intentionally and purposefully frame science content online to influence audiences’ thinking to achieve various audience outcomes. Because of the widespread reach and importance of their science communication in reshaping public conversations about STEMM, we focus on these SIs’ framing of content on Instagram by examining their selection of subjects (i.e., topics or issues), creation and highlighting of information (i.e., message frames), and presentation of platform-specific features and trends (i.e., communication tactics). We address three research questions (RQs):

RQ1: What *topics or issues* are selected by women astronaut SIs in their content shared on Instagram?

RQ2: What *message frames* are created and highlighted by women astronaut SIs’ in their content shared on Instagram?

RQ3: What *communication tactics* are presented by women astronaut SIs in their content shared on Instagram?

2 - Method

2.1 - Sampling

Our study sample consisted of 194 publicly available Instagram posts shared online from June 24, 2024 (public announcement of the spaceflight) through November 24, 2024 in Instagram accounts by Kellie Gerardi [Gerardi, n.d.], Norah Patten [Patten, n.d.], and Shawna Pandya [Pandya, n.d.]. Prior research of social media content has utilized a range of sample sizes including 40 [Habibi & Salim, 2021], 100 [Eriksson Krutrök & Åkerlund, 2023; Jacques et al., 2023], 134 [Hautea et al., 2021], and 150 [Huber & Baena, 2023], indicating that a sample size of 194 is sufficiently large. Infegy, a social media analytics service, provided the posts by conducting username searches (“kelliegerardi”, “norahpatten”, and “shawnapandya”) and author searches (“Kellie Gerardi”, “Norah Patten”, and “Shawna Pandya”). We selected Infegy because post collection is significantly higher than for other social listening providers while compliant with API guidelines. For each post, Infegy provided URL links to post content

(i.e., text, captions, hashtags, images, video, audio, song lyrics, and emojis), caption transcripts, and user engagement metrics (i.e., likes, comments, shares).

We stored data on an Excel spreadsheet to facilitate simultaneous viewing, listening, and reading of posts during analysis. Although all posts are publicly available and the researchers did not interact with the SIs, a “Research Determination” was submitted to the University IRB, which made a “Not Human Subject Research Determination”. As recommended by the University IRB Board, the researchers made several attempts to notify the SIs about this study. While standard internet research ethics practice recommends minimizing identifiability in presenting and reporting [Lukito et al., 2023], the science influencers selected for this study were highly visible, widely recognized public figures whose professional activities are inherently tied to public engagement across multiple media channels. In the context of this study, the use of their names and post content did not pose additional ethical risk and is consistent with ethical guidelines governing the use of public data.

2.2 ■ *Data analysis*

We analysed the selected posts using a reflexive thematic analysis [TA: Braun & Clarke, 2006, 2021]. This methodology is especially useful for exploring patterns in the dataset and identifying themes that describe post content related to research questions, while recognizing the researchers’ active role in interpretation and knowledge production [Braun & Clarke, 2019]. Our decision to use this methodology was based on prior research that used reflexive TA to analyse social media posts [e.g., Davis et al., 2023; Turner et al., 2023]. Our analysis was reflexive, collaborative, and recursive; that is, all three authors thoroughly reviewed and interpreted the data, discussed the data, and modified interpretations throughout the analysis to achieve richer interpretations [Byrne, 2022]. We utilized a Microsoft Excel spreadsheet containing our dataset to record codes, themes, notes, and other observations during the analysis, creating additional columns as our analysis advanced.

Reflexive thematic analysis is a recursive and iterative process. First, to familiarize ourselves with the dataset, each author independently viewed each post, one at a time, holistically (i.e., watched videos and video carousels, viewed photographs and photo carousels, read post caption transcripts, read onscreen and post captions and hashtags, listened to audio, reviewed hashtags and emojis). We used an inductive approach to identify social media science communication practices. Next, we met together to discuss our observations. We decided to focus on three specific science communication practices related to our research questions: (1) selection of Topics or Issues used to direct audiences’ attention on what information to think about, (2) creation of Message Frames¹ used to direct audiences’ attention on how to think about information, and (3) presentation of Communication Tactics used to direct audiences on where to focus their attention. Second, we identified codes for each of these three areas of focus. The authors independently coded the first 15 posts in the dataset, meeting to discuss and resolve coding discrepancies before equally dividing and coding the rest of the dataset. We coded the full post (text, emojis, audio, visual images,

1. We carefully considered the labels we assigned to categories, codes, and themes throughout the analysis. As we reflected on our categories of analysis, we shifted to Message Frames (which previously we had referred to as Audience-Outcome Goals as described in Besley and Dudo’s 2022 Strategic Science Communication Framework) to more precisely describe the framing practices we observed in the dataset and to better align our analysis with our theoretical focus on framing.

videos) as a single unit of analysis, considering a code to include all text, visual, and audio content [Saldaña, 2021] that summarized, described, represented, symbolized, or evoked a specific attribute of strategic social media science communication practice (i.e., Topics or Issues, Message Frames, Communication Tactics). A single post could be coded as exhibiting or reflecting multiple codes. We met to discuss and resolve coding discrepancies (e.g., the Topics or Issues codes of “Ireland” and “Canadian pride” became a Topics or Issues code of “national representation”; the “break gender stereotypes” and “feminist empowerment” codes were combined into the broader code “break stereotypes”). Third, we grouped related codes together to generate initial themes, moving from description to interpretation of the dataset. We created and defined, collectively, initial themes to explain patterns observed in the dataset. For example, two distinct Message Frames codes “explain science” and “communicate about science” were viewed as related and grouped together under one theme: “educate others”. Fourth, we reviewed initial themes, looking for patterns and combining similar themes (e.g., “props” and “astronaut footage” were combined to become “visual props” to describe Communication Tactics). Fifth, we discussed and refined theme names to create labels and provide definitions. Sixth, we reviewed all final themes by area of focus (e.g., Topics and Issues, Message Frames, and Communication Tactics) and wrote a detailed report on meaning [Braun & Clarke, 2021] interpreted from in the dataset, choosing evocative exemplars [Saldaña, 2021].

To further enhance the trustworthiness of our analysis, we followed several interrelated practices. We immersed ourselves in the data (e.g., watching videos, reading caption texts and hashtags, listening to audio, and noting emojis), held weekly debriefing meetings to discuss similarities and resolve discrepancies, engaged in reflexive writing through memos and notes, and kept an ongoing audit trail by recording our WebEx meetings, keeping process notes, and recording all decisions made during our weekly meetings [Lincoln & Guba, 1985; Nowell et al., 2017].

2.3 ■ *Positionality statements*

Reflexive TA emphasizes the role of the researchers in constructing findings [Braun & Clarke, 2021]; thus, we present our positionality statements. The first author is a doctoral student who focuses on the applied, practical impact of communication informed by theory to increase organizational problem-solving capabilities. Throughout the analysis, she focused on applying a strategic applied lens to the findings that might help drive future strategic choices for science influencers. The second author is a doctoral student whose research explores how stigmatized identity intersects with new media. With a background in STEMM and experiential learning, she focused on how the SIs represented themselves and communicated with their audiences. The third author is a university professor who teaches science communication and conducts research on media portrayals of women in STEMM and their influence on adolescent girls’ STEMM identity. Her perspective focused attention on the SI’s framing of identity and their use of social media science communication strategies to shape audience engagement and interpretation.

3 ■ **Results**

In addressing the RQs, we identified six Topics or Issues, seven Message Frames, and five Communication Tactics described below to advance understanding of the use of framing in

strategic social media science communication by Kellie Gerardi, Shawna Pandya, and Norah Patten on Instagram. Additional exemplars can be found in the appendix.

3.1 ■ *Topics or issues*

We identified Topics or Issues first to determine the subjects that the SIs addressed in their Instagram posts. We identified six Topics or Issues: *Share experiences and showcase contributions in STEMM*, *“I am a woman in STEMM”*, *Road to STEMM*, *STEMM spokesperson*, *#LIFE*, and *#Influencer*.

3.1.1 ■ *Share experiences and showcase contributions in STEMM*

Each astronaut shares content related to experiences in STEMM that highlights their contributions in these fields. These posts include footage of parabolic microgravity practice flights, experiments, and explanations of scientific concepts. For example, in a carousel of images posted by Gerardi, she explains the type of research the team will be conducting in space. The post includes images of research on women’s health and fluid behaviour on Earth and in parabolic flights. Gerardi’s caption adds a detailed description of their research, why it is important to conduct experiments in microgravity, and how the astronaut team works together in short bursts of freefall.

Pandya and Patten share similar posts related to their scientific research. Pandya shares a video of intrauterine device (IUD) insertion in microgravity, along with a caption of why women’s health research in space is important. Patten shows a video of herself in microgravity, sharing, “As we completed each parabola, I became more and more comfortable in this environment, more and more at ease, more and more familiar with the conditions of working in this truly unique environment” [Patten, n.d.]. Posts like these often include action-focused images and visual props to further showcase the research and contributions of these astronauts, providing opportunities to excite multiple potential audiences about space and encourage public support of space exploration.

3.1.2 ■ *“I am a woman in STEMM”*

All three astronauts post experiences related to how they navigate traditionally male-dominated STEMM fields as women. These posts highlight their accomplishments, offer support to other women in STEMM, and, importantly, challenge traditional stereotypes of who can be and succeed in STEMM. For example, Pandya shares a video directly challenging inaccurate assumptions that the all-female crew is a diversity hire by sharing a variety of short clips and still photos of each astronaut along with on-screen text describing their individual accomplishments. This includes Patten being formally recognized during a speech given by former President Joe Biden, Gerardi’s invitation from former First Lady Dr. Jill Biden to read her children’s book at the White House, and Pandya’s recognition of her work by former Canadian Prime Minister Justin Trudeau. At the end of this video, Pandya directly challenges stereotyped assumptions about their roles in STEMM, by noting that the use of the term “diverse” should instead be used to represent the wide breadth of skills and experiences each member of the team possesses.

Gerardi takes a slightly different approach in her attempt to alter gender stereotypes of women in STEMM. She shares a video in which she asks her daughter, Delta, to hypothesize

what she thinks a small stuffed octopus would do in microgravity. Her daughter says that she thinks the tentacles of the octopus will float up and down. In the next clip, Gerardi shows the octopus in microgravity in motion exactly as hypothesized by her daughter. This short-form video, which includes clips from different perspectives including shots from earth and in space, visually increases interest in the content. By including her daughter testing a hypothesis in an approachable way and sharing footage of herself in microgravity during a flight, Gerardi both expresses these important dimensions of her identity and expands public perceptions of what it means to be a working mother and an astronaut, challenging traditional gender roles for women.

3.1.3 ■ *Road to STEMM*

All three SIs highlight pivotal life events or people who shaped their STEMM pathways. For example, in a “Throwback Thursday” post, Patten shares a photograph of herself at age 15 in front of a spacecraft during her first visit to the Kennedy Space Center in Florida with her father and brother. In the caption, she recalls “the excitement and awe I felt walking under the Saturn V in the visitor complex” [Patten, n.d.]. Similarly, Pandya posts about memorable childhood events that shaped her STEMM pathway. She shares two photographs at age 14 participating in Girl Guides of Canada, noting the importance of learning problem-solving skills early on. Of all the SIs, Pandya most often posts about influential people who shaped her career, sharing a post featuring a photo of a mentor on screen during a speaking engagement at an event for young professionals.

By sharing memorable moments and acknowledging supportive mentors who inspired them, the SIs model varied paths to STEMM and often directly encourage their audiences, including young audiences, to consider their own pathways in STEMM. Posts intended to inspire girls to consider STEMM careers often feature the SIs directly talking about STEMM careers, while appearing in pink, purple, glittery clothing, makeup, and accessories like friendship bracelets that are likely to appeal to young girls and attract their attention. Posts like these reflect the SIs’ personal values while reaching out to an historically underrepresented and marginalized group in STEMM.

3.1.4 ■ *STEMM spokesperson*

Posts shared by the SIs often show members of this all-woman astronaut team attending press or public events to promote their research, upcoming historic flight, and other team members. In these instances, the SIs act as STEMM spokespeople and role models, showcasing who can be a person in STEMM. In one post, Pandya sings the national anthem and throws out the first pitch at a collegiate baseball game while wearing her flight jacket. In one of Patten’s posts, she shares images of visits to the Irish Embassy in Canada with Pandya; both astronauts wear their flight suits and highlight their national flags. All SIs post photos or video clips from talk show appearances that focus on their discussions of how few women have gone to space or promote their upcoming Virgin Galactic research. These posts advance the personal agendas of the SIs while also enhancing their visibility, voice, and professional status as women in STEMM.

3.1.5 ▪ #LIFE

Some of the posts by the SIs centre on subjects related to non-STEMM-related personal life experiences. For Gerardi, these frequently include posts about pregnancy loss, in vitro fertilization (IVF), and infertility. For Pandya, this includes posts about social events such as a post of a photo carousel of “a celestial lightshow from blazing Northern Lights” [Pandya, n.d.] on her drive home from working at the hospital one night or a photograph from a concert at the Barclay Center in New York City. Patten, similarly, often posts about personal travel.

Some of the posts about personal life experiences focus on strategies for balancing work and motherhood. For example, Gerardi posts content about how the Virgin Galactic team made celebrating Halloween with her daughter, Delta, possible when in-flight training was scheduled for Halloween. Patten posts a video with her two-year-old daughter looking at the children’s book she wrote, *Shooting for the Stars*. Patten asks her daughter, “where’s mummy going” and her daughter responds, “far away” [Patten, n.d.]. Sharing these personal moments humanizes the astronauts to promote authenticity and forge personal connections with their audiences while simultaneously challenging gender stereotypes of women in STEMM.

3.1.6 ▪ #Influencer

All three influencers seek to build and diversify their audiences by popularizing STEMM in novel ways likely to promote public interest and engagement. The astronauts share posts featuring their participation in sponsored events, often with a space-inspired twist. Gerardi posts frequently on this topic as she combines her science outreach with sponsored opportunities available to her because of her large social media following. In one post, Gerardi shares photos and videos of her appearance during New York Fashion Week. One video captures Gerardi on the catwalk, wearing a dress featuring flowers and images of space stations, with her daughter, Delta, wearing a gold star tiara and glittery, star-patterned dress, and Gerardi’s mother on the catwalk by herself wearing a similar dress as Gerardi’s. Posts like these highlight Gerardi’s role as both an influencer and a scientist.

For posts related to this theme, Pandya focuses more on her work as a scientist. One of her videos shows the neutral buoyancy lab, the large pool where much of their training takes place prior to parabolic microgravity flights. She narrates using a voiceover about what it’s like floating in the pool, giving a behind-the-scenes look at space training. Although they have different ways of sharing information, the astronauts are united in all wanting to spark audiences’ interest in and engagement with STEMM. While Gerardi often takes a more personal approach in her posts, Pandya typically takes a scientist-focused approach in her posts.

3.2 ▪ Message frames

We identified Message Frames to describe the SIs’ selection of content to highlight information and focus audiences’ attention as they seek to influence the ways audiences think about an issue [Besley & Dudo, 2022; Nisbet & Mooney, 2007]. We identified seven Message Frames: “Get to know me”, *Celebrate STEMM wins*, *Stomp STEMM stereotypes*, *Open doors to STEMM*, *Showcase team @virgingalactic #spaceteam*, *Share knowledge*, and *Home pride*.

3.2.1 ■ *“Get to know me”*

Some posts by the SIs focus exclusively on details about their personal lives and are used to encourage audiences to connect with them to increase their follower base. For example, Gerardi occasionally posts videos responding to specific questions she receives from followers about personal experiences. In one video, she answers questions regarding how she balanced IVF treatments with space flight preparations: “I saw some great questions and just wanted to clear this up since a lot of people (very understandably!) were confused about what it would mean for my career if I got pregnant right now!” [Gerardi, n.d.]. Gerardi is vocal and honest about her fertility struggles online, often sharing videos that show her crying about negative pregnancy tests and describing the many medications that come with treatment. These posts are raw and emotional, inviting audience members to get to know her on a deeply personal level.

Pandya and Patten also post personal details to help the audience learn more about them. Patten posts “throwback” images of herself as a child, demonstrating her love of space and STEMM. Pandya also shares images of herself as a child, using the posts to discuss how she was raised. Pandya also takes to social media to share her travels, such as trips to New York City to see her favourite band, Linkin Park. Although the SIs frame these experiences differently, they all invite audiences into their personal lives through social media, providing intimate views of their lives through personal self-disclosure, which encourages audience identification and connection. These actions to promote audience connection are often closely linked and directly tied to the *#LIFE* topic noted above.

3.2.2 ■ *Celebrate STEMM wins*

Promoting audiences’ appreciation of STEMM and recognition of STEMM discoveries and historic milestones is reflected in posts by the astronauts celebrating their personal and STEMM accomplishments. For example, Pandya shares a video of her parking spot at the hospital where she works, showing that it is parking for physicians, then adds a sticker on top for “astronaut parking” [Pandya, n.d.]. In this manner, Pandya showcases her varied skill set as both a medical clinician and an astronaut. Patten takes a more humorous approach in some of her posts, sharing a video consisting of a compilation of clips she took from her travels to Canada for the team’s microgravity flights. In her caption, she writes that she is “still figuring out how to make solo international travel look exciting...” [Patten, n.d.]. Celebrating STEMM wins also includes celebrating advances in the field more broadly. For example, Pandya shares a short video clip that shows her joyous reaction to an image of astronauts from the first private spacewalk in new spacesuits. By celebrating their achievements as well as the accomplishments of others, the SIs promote excitement about STEMM for their audiences and convey personal beliefs about the value and benefits of STEMM research and space exploration.

3.2.3 ■ *Stomp STEMM stereotypes*

The SIs frequently present images of women from diverse backgrounds in STEMM in their posts, thus providing varied representations of who can be or is successful in STEMM. These images challenge existing gender stereotypes and advance positive representation of women in STEMM. Relatedly, some posts by the SIs directly address public misconceptions and

gender-stereotypes of STEMM fields. The SIs also appear frequently in posts wearing feminine space-themed clothing (e.g., dresses covered with stars or the planets) to visually reinforce their presence as women in STEMM. This theme often coincides with the theme, “*I am a woman in STEMM*” noted above.

A poignant example of this theme is a video that Gerardi posts of several women astronauts from diverse racial and ethnic backgrounds seated around a table at a restaurant following a New York Fashion Week event, which notes the limited number of women astronauts. Another example appears in a video carousel in another post, in which Gerardi directly addresses public misperceptions about women and femininity in STEMM. The first clip in this video carousel shows Gerardi smiling as she rips badges from her navy flight jacket and places them on a pink flight jacket along with this on-screen caption: “When my 6-year-old daughter asks why my flight jacket can’t be pink” [Gerardi, n.d.]. In the next clip, Gerardi’s daughter, Delta, jumps up smiling while pointing to an image of her mother on television wearing the pink flight jacket during an interview. The onscreen caption states: “so you surprise her on TV” [Gerardi, n.d.]. Gerardi’s message is reinforced by the song lyrics “Mama said that it was okay” [Gerardi, n.d.], and the post caption in which she thanks IAS for expanding the official crew flight jacket options and shares with girls that femininity or fun does not undermine credibility and professionalism. In other posts, Gerardi and Patten both advance more diverse representations of a modern woman in STEMM by sharing their experiences as working mothers and scientists.

3.2.4 ■ *Open doors to STEMM*

All the SIs in this study discuss the importance of STEMM mentors who helped them succeed, as also addressed by the topic, *Road to STEMM*, as they encourage and open doors for audience members who view their posts. For example, Pandya posts an image that illustrates this theme by showing a video in which she states: “This one’s for tomorrow’s astronauts, and the astronauts for the day after that and the day after that” [Pandya, n.d.]. In this post, she explains that her interest in space emerged from watching Roberta Bondar, Canada’s first female astronaut, then assisting Gerardi on her first space mission, before pursuing space herself. In other posts, Patten frequently shares how she is proud to be the first Irish astronaut, hoping her career will inspire other Irish citizens to join her in this space legacy. Through these posts, the SIs stress the importance of mentors and role models in opening doors to STEMM, encouraging audiences to consider how support systems might enable them to forge their own pathways or how they, in turn, might support others.

3.2.5 ■ *Showcase @virgingalactic #spaceteam*

In anticipation of their upcoming mission, the astronauts frequently share content to highlight and publicize the work and preparations of the three-member, all-women astronaut team. This includes posting appearances directly promoting the mission, sharing snippets from their training, celebrating team accomplishments, and showcasing their camaraderie. A post from Pandya shows a short clip of the three women high fiving each other, with text overlay describing how well they work together along with music and a caption that highlights the team. In another post, Pandya shares a clip from a parabolic microgravity practice flight showing Gerardi catching an item from behind Pandya’s back before it hits Pandya. These posts provide widespread publicity for the upcoming historical space mission,

stress the collaborative nature of research, and emphasize the importance of teamwork, while seeking to garner public interest and advance public support for space science.

3.2.6 ▪ *Share knowledge*

All three SIs provide content that shares scientific knowledge intended to promote greater understanding of STEMM. To achieve this, the SIs present science content that explains and/or highlights the importance of STEMM concepts, research, and experiments, often using catchy or trendy phrasing. For example, in one video carousel, Pandya notes in the post caption: “Time for a 0g physiology lesson: Maybe she’s born with it” [Pandya, n.d.]. To promote engagement and understanding, she uses hand gestures, facial expressions, emojis, space-related visual props (flight jacket, scientific apparatus), onscreen captions that provide a detailed explanation, and sets the video to Roy Orbison’s, “Oh Pretty Woman”. Similarly, Patten shows a video of a Falcon 20 jet and explains how it is used in microgravity research flights, using captions, photographs, emojis, and hashtags set to Coldplay’s “Adventure of a Lifetime” to promote engagement and understanding. Overall, the SIs provide educational lessons often using a variety of communication strategies (e.g., visual props, captions, emojis, hashtags, audio) to explain various scientific topics. Using these communication tactics to share knowledge makes the information more interesting, dynamic, and easier to understand.

3.2.7 ▪ *Display home pride*

The Virgin Galactic team includes women who represent three different nationalities. Pandya is a Canadian woman of Indian heritage, Patten is an Irish woman, and Gerardi is an American woman. While all three SIs share the pride of being among the first 100 women to go to space, Pandya and Patten also discuss the pride that comes from representing their home countries. Both Pandya and Patten are making history, with Pandya being the first Canadian woman to become a commercial astronaut and Patten being the first Irish person to go to space. In their posts, they share news articles and interview clips highlighting their historic careers and upcoming spaceflight. In an interview shared on Instagram, Patten states, “Ireland’s involvement in the space sector is going from strength to strength”. She goes on to discuss her own journey to becoming the first Irish person in space. Pandya also posts similar content, highlighting Canada’s contribution to space research and sharing how proud she is to leave her own mark in the field. This display of national pride appears in almost all posts shared by Pandya through intentional use of hashtags such as #indianastronaut and #candianastronaut.

3.3 ▪ *Communication tactics*

We identified Communication Tactics to determine the specific strategies used by the SIs in their Instagram posts to highlight and point audiences’ attention to their posts or to specific elements in their posts. We identified five communication tactics: *Post format*, *Standard Instagram features*, *Instagram trends*, *Humour/word play*, and *Visual props* for the topics addressed and message frames selected.

3.3.1 ▪ *Post format*

Posts shared by the SIs range in format type. Gerardi is fond of short-form videos, although occasionally posts still images or photo carousels. Patten most frequently posts still photos or photo carousels. Pandya often posts video slideshows or carousels that involve a combination of still photos and short video clips. Typically, each SI presents posts similar in format, promoting familiarity that helps advance a personal brand for audiences.

3.3.2 ▪ *Standard Instagram features*

All three women SIs use a variety of standard Instagram features in their science communication. These features include onscreen captions or caption overlays, post captions, emojis, tags, hashtags, and collaborative posts. Posts frequently include several or all features in combination. For example, Gerardi posts a response to a comment from an audience member (i.e., “just because you flew to space doesn’t mean your whole life has to be space-themed...”) [Gerardi, n.d.] as an onscreen caption or overlay along with a post caption that includes emojis and hashtags: “Pretty sure it’s a legal requirement!! (And space was destined to be the entirety of my personality from the day I was born, right here in Jupiter Florida” [Gerardi, n.d.]. Collaborative posts are used infrequently compared to standard posts. One particularly poignant example is a video posted by @amandangocnguyen with Gerardi and 10 other women astronauts who appear with confident looks and poses. The caption overlay states these women represent 10% of the world’s astronauts and the post caption describes them as “trailblazers” for the communities they serve: India, Afro futurism + Nigeria, Italy + motherhood, Vietnam, Purépechan-Mexican, West Virginia, Egypt, Pediatric Cancer Survivor. Pandya often uses the same hashtags, including #candianastronaut, #indianastronaut, #womeninSTEM, #daretoexplore, #pushthe limits, to connect with diverse audiences. The use of standard Instagram features helps the SIs communicate in a variety of ways and allows use features that audiences frequently expect from creators, creating consistency in content to advance their personal brand.

3.3.3 ▪ *Instagram trends*

Instagram, like all social media platforms, capitalizes on trends. These trends, such as sound, music, and popular culture references, add to an intricate algorithm that brings posts to new audiences. Each astronaut integrates Instagram trends in their posts. Patten and Gerardi both referenced pop stars, with Gerardi calling herself a “bratstronaut” [Gerardi, n.d.] in reference to Charli XCX’s hit album “brat”, and Patten posting “move over Taylor Swift, Norah is back in town” [Patten, n.d.] in reference to Swift recently touring in Ireland. Pandya has found ways to capitalize on music that elevates the post itself. For example, she posts clips of herself working as an astronaut to the song “Space Oddity” by David Bowie. Pandya times her clips to fit with the lyrics, such as showing the Virgin Galactic team floating in microgravity as Bowie sings about floating. Because the song is about a fictional astronaut, the music complements Pandya’s content, giving the lyrics new meaning. Similarly, Gerardi shares clips of her and her daughter attending the Kids’ Choice Awards dressed in SpongeBob-themed attire. Throughout the clips, Gerardi lip-synchs to the Plankton remix of “Pink Pony Club”. Use of this trending sound increases the likelihood that her post would appear frequently in users’ feeds. Overall, each astronaut clearly demonstrates that they can capitalize on Instagram trends to elevate their content and further their reach to new and diverse audiences.

3.3.4 ▪ *Humour/word play*

All three astronauts utilize humour and word play to entice laughter or amusement from their audiences. This type of content often features puns, satire, idioms, a play on words, and other text, video, and audio features designed to be humorous. Patten's use of humour tends to be relevant to an Irish audience, such as a post where she called herself "equally delicious" [Patten, n.d.], referring to the jingle for the cereal *Lucky Charms*, in response to an Irish creator who has over 1 million followers sharing her accomplishment on his Instagram. Pandya prefers to use a light humorous tone and make it clear to her audience when she jokes, such as in a post where she shares pictures of other astronauts and uses humorous word play on their names to show what an astronaut looks like. In her video and caption, she makes it clear that the tone is meant in jest. Gerardi also uses humour that is more likely to resonate with her national audience. This is seen in a short form video she posted poking fun that her love for Halloween is greater than her love for space, although, like Pandya, she explains that the joke is meant in jest in her caption. The use of humour helps keep the mix of content shared fresh to followers and allows each astronaut to show her individual personality.

3.3.5 ▪ *Visual props*

Posts shared by the SIs frequently use visual props or objects (i.e., professional astronaut footage, clothing, accessories, home décor, party goods) or people to further emphasize their message or interest in space or STEMM. For example, Gerardi, Patten, and Pandya appear in flight suits and space suits, but Gerardi and Patten also appear in space-themed clothes and accessories such as a star-patterned dress, galaxy-patterned dress, star-patterned cardigan, space-themed t-shirt, and space-themed or star bracelet. Gerardi's posts, including posts about her career shower, also feature space-themed home décor (e.g., rocket ship model, star wall hanging), party goods (e.g., star wrapping paper), food (e.g., cookies decorated with friendship bracelets that reads "Astronaut ERA" [Gerardi, n.d.] or the name of the upcoming space mission, quiche with star decoration), and toys (e.g., stuffed astronaut bear in rocket ship, extraterrestrial alien pillow). In several posts, Gerardi shows "Astronaut Barbie" to attract attention and advance the goal of inspiring girls in STEMM. Gerardi also often includes her daughter, Delta, mother, and occasionally, husband to advance messages about the compatibility of motherhood and STEMM.

Another frequently used visual prop appearing in posts by all the SIs is real-life astronaut footage of space flights that the SIs have participated in or other recent space flights. This footage not only reinforces the credibility of the SIs as women astronauts but also celebrates significant accomplishments in space exploration and research. The variety of different props and people in the videos provide additional context that is likely to draw attention and interest to their content.

4 ▪ Discussion

This study sought to advance understanding of how three prominent women astronaut SIs utilize framing in social media science communication in practice on Instagram. Findings describe how these SIs purposefully and intentionally construct content on Instagram to focus audiences' attention on *what to think about* [topics; Entman, 1993], *how to think about*

it [message frames; Entman, 1993; Nisbet & Mooney, 2007; Scheufele, 1999], and *where to direct their attention* [communication tactics; Scheufele, 1999]. Findings not only document strategic use of framing on social media but also reveal how these SIs shape content to establish and reinforce a personal brand, enabling them to build and diversify their audiences. Through the topics and issues selected, frames created, and tactics presented, these SIs strategically utilize framing to advance strategic social media science communication and promote public science engagement. Findings have practical applications for science communication training and theoretical implications for advancing understanding of the crucial role of framing in strategic social media science communication.

These women astronaut SIs select specific topics and issues they deem important to highlight for their audiences on Instagram. These topics or issues primarily focus on STEMM, often specifically those related to astronomy, space science, and medicine, which are areas of expertise for these SIs. However, several issues more broadly describe their STEMM experiences and contributions as STEMM professionals, often calling attention to and highlighting their contributions as women in STEMM. Prior research on women SIs and content creators similarly noted the use of social media to gain visibility and to underscore the injustices faced by women in STEMM [Huber & Baena, 2023; Steinke, Coletti & Gilbert, 2024; Steinke, Gilbert et al., 2024; Suk et al., 2026; Wells, 2022]. By sharing and calling attention to their STEMM experiences and contributions in these digital environments, the women astronaut SIs not only achieve visibility but also legitimacy through “visual space-making” [Suk et al., 2026, p. 1]. Framing science and science communication by selecting specific topics and issues also aligns with one recommended objective for achieving audience-centric goals through strategic science communication [Besley & Dudo, 2022].

The topics or issues selected in the Instagram posts by these SIs often also focus on personal topics and issues (i.e., sharing content related to their personal life), which is dissimilar to the topics and issues often evident in science communication seen in traditional media channels. It is important to note that by conveying authenticity and encouraging personal connections, SIs can promote online relationships useful for building larger audiences [Hund, 2023]. This may reflect the SIs’ attempt to show that although they are scientists, they are not that different from their audience members, which is another recommended objective for achieving effective strategic science communication [Besley & Dudo, 2022].

The message frames created by the SIs represent the ways in which they intentionally seek to influence how audiences think about the information they share in their Instagram posts. For example, some of the message frames created by the SIs emphasize the importance of opening doors to others considering STEMM careers, share information about women’s health topics and the importance of women’s health research, show behind-the-scenes looks at how they prepare for a spaceflight, highlight their contributions as women in STEMM, and reflect their personal values and interests. The creation of these frames may be an effort to direct and shape audiences’ message processing and interpretations, which has been identified as especially important for achieving audience-centred behavioural goals necessary for effective strategic science communication [Besley & Dudo, 2022].

Of note, some of the message frames created, as seen with the topics and issues selected, focus on sharing personal information using a “get to know me” approach, while others focus

on sharing scientific information. This personalization of content offers a glimpse of the SI's life outside of STEMM, often by answering questions from an audience member's comment, sharing childhood memories, or showcasing family events. This finding aligns with common practice among influencers used to increase visibility in algorithmically driven platforms [Carpenter et al., 2023]. Relatedly, other studies have found that scientists often address personal topics and share content related to non-STEMM experiences in their science communication [Coletti et al., 2022] to present themselves in ways that humanize them and promote audience identification to broaden public reach [Bainotti, 2024; Zhang & Lu, 2026]. Overall, findings related to the SIs' message frame creation suggest that they seek to influence not only how their audiences think about scientific topics and issues but also try to connect with them on a more personal level. This practice of using warmth-related communication through first-person storytelling is another recommended objective identified as important for effective strategic science communication [Besley & Dudo, 2022].

Findings related to the presentation of communication tactics underscore the SIs' creativity, adeptness, and savvy as content creators and communicators. While the choice of topics and issues as well as frames are important for social media content creation, content also must be delivered using communication tactics appropriate to the platform and that will stand out and capture the attention of various audiences. Posts by these SIs typically vary in format and design, frequently capitalizing on popular Instagram trends and features. These include trending sounds, hashtags, or emojis likely to increase visibility of posts in both followers' and non-followers' feeds [Biggs & Moore, 2025]. Additionally, many of the posts leverage Instagram's focus on visual displays and appeals using visual props, such as flight suits, footage of micro-gravity flights, space-themed decor or clothing, and even other family members. The SIs' use of communication tactics like these highlight certain elements of a post, often seeking to attract audiences' attention through creativity, humour, or surprise. Integrating popular social media trends, like audio or memes, into social media posts may be especially important for promoting public science engagement for non-STEMM-focused and young audiences. Popular social media trends and features (e.g., trending sounds, music, video techniques) appear to be especially crucial for attracting the attention of young social media audiences to STEMM content [Spang & Steinke, 2026]. Not only do communication tactics like these draw interest, but they also provide cognitive shortcuts to guide interpretation and bolster the visibility of these SIs to broaden their reach and expand their audiences [Radin & Light, 2022].

It is important to note that not all topics and issues, message frames, and communication tactics appear in the exact same ways in posts shared by the three SIs. Gerardi, who has the most followers, often capitalizes on her influencer status. She frequently combines her scientific outreach with sponsored events, such as New York Fashion Week or the Kid's Choice Awards. Gerardi's increased online presence provide her with more opportunities for monetizing brand deals, a trait of a successful social media influencer [Carpenter et al., 2023]. Another difference seen in the SIs' selection of topics and message frames relates to the astronauts' diverse identities. While all SIs promote women in STEMM, Pandya and Patten actively promote their national identities as well. Pandya, a Canadian woman of Indian heritage, and Patten, an Irish woman, acknowledge their historic career paths. Many of their posts include images of the Canadian or Irish flags, as well as information promoting their home country's contributions in STEMM. This practice aligns well not only with the recommended strategic science communication objective of showing that you are not that

different from others [Besley & Dudo, 2022] but also with recommendations for inclusive science communication practice [Canfield & Menezes, 2020].

Strategic science communication emphasizes the importance of careful, planned, deliberate decision-making when crafting messages about science, offering scientists and other science communicators a framework of evidence-based guidelines that focus attention on specific audience-centred goals, objectives, and tactics [Besley & Dudo, 2022]. Framing is an important objective noted in this framework and crucial for achieving audience-centred behavioural goals because framing shapes “a conversation (and the frames in people’s heads) in ways that change behaviours” [Besley & Dudo, 2022, p. 253]. Overall, findings from this study provide evidence of the use of framing as *strategic social media science communication*. Further, findings from this study also suggest strategic use of framing to highlight the SIs’ specific agendas, identities, values, beliefs, skills, expertise, and personality to develop and advance a personal brand [American Marketing Association, n.d.]. All three SIs actively use framing in their attempts to attract, engage, and build large, diverse, networked audiences in a saturated and competitive media environment, positioning their personal brand to help them differentiate themselves and their science communication from other SIs on Instagram.

Strategic communication has been described as an approach that can be used to achieve stakeholder-focused goals [Hallahan et al., 2007; Thomas & Stephens, 2015]. Strategic social media communication, in particular, centres on offering consistent experiences that strengthen emotional ties with online users [Felix et al., 2017]. While social media is a relatively low-stakes financial investment, it involves a heavy time investment and constant consideration of overall strategy [Plowman & Wilson, 2018]. Findings from this study extend extant research to describe *strategic social media science communication* in meaningful and potentially transformative ways to advance public engagement with science or STEMM.

4.1 ■ *Theoretical implications*

This study focuses on the deliberate framing of social media science content by looking at the topics or issues, message frames, and communication tactics embedded in publicly shared Instagram posts by three prominent women astronaut SIs. This analysis provides evidence of strategic social media science communication in practice, describing how the SIs frame science content on Instagram. Findings suggest that these science communicators do, in fact, act strategically as they purposefully and intentionally frame science content. Importantly, study findings also reveal these SIs’ framing practices on Instagram are varied and complex, shaping content through the creation of posts that address specific topics and issues, selection of message frames, and presentation of communication tactics. These framing practices appear to be integrated into the strategic social media science communication practices of the SIs and used to guide and direct audiences’ processing of content to shape their interpretation of content, specifically, what to think about, how to think about it, and where to focus their attention. Findings from this study, overall, provide a more nuanced and complex perspective on the framing of content on social media.

4.2 ■ *Practical implications*

This study contributes to the literature on strategic science communication and advances understanding of strategic science communication in practice and as applied to social media

science communication. Our research presents several practical implications for scientists and science communicators seeking to promote public engagement on social media. First, our analysis suggests the importance of training focused on framing content, with equal consideration given to the creation of posts focused on topics and issues, selection of message frames, and presentation of communication tactics. All three elements appear to be integral and inextricably linked when considering framing within the context of strategic social media science communication. This aligns with recent recommendations for strategic considerations for sharing science information on social media [Lindenfeld et al., 2025].

Second, findings from this study suggest that framing is central to strategic science communication on social media and is pervasive in practice for these prominent science influencers. Overall, our findings advance understanding of communicators' selective and strategic message framing in this context as they seek to link (and match) their message frames with audience frames [McLeod et al., 2022; Scheufele, 1999]. On social media platforms, framing provides important opportunities for a marginalized group like women in STEMM to craft new narratives and redirect public discourse about gender and STEMM, conferring not only visibility but also legitimacy and authority for their work that is often unattainable in physical STEMM environments [Suk et al., 2026].

Third, our analysis found that strategic social media science communication included personalization or sharing multiple facets of their personal lives and stories on Instagram in addition to scientific content, a hallmark of the platform that is especially favoured by women SIs [Steinke, Coletti & Gilbert, 2024]. Sharing content that goes beyond STEMM experiences and scientific facts highlights that the SIs are (strategically) aware of what social media audiences have come to expect from influencers, recognizing the need to embrace social media features, trends, and affordances to promote identification, build audiences, and advance their agendas. Prior research suggests that scientists who go beyond the sharing of only scientific facts might be better positioned to be viewed more positively by their audiences [Zhang & Lu, 2026]. Future training programs for science communicators can incorporate ideas for humanizing their experiences through personal stories on social media. Additionally, future training for science communicators should underscore social media posts as advancing a personal brand. Social media can provide scientists with opportunities to differentiate themselves from other scientists.

4.3 ■ *Limitations and future directions*

Our study has several limitations. First, while we focused on how topics, message frames, and communication tactics were manifested in messages created by these SIs, our observations are shaped by our perspectives and experiences. As an analysis of media content focused on framing information manifested in social media content, this study did not directly assess the goals and objectives of the SIs. Future research should ascertain if our observations align with the actual intentions of the SIs using surveys or interviews. For example, future research can interview SIs to understand their perspectives and compare the findings with an analysis like the one in this study to compare framing manifested in content compared to the goals of the creator. Another limitation was that our dataset focused on a small group of SIs, only explored one social media platform, and was limited by searching strategies and API search limitations. Future research should assess larger datasets, consider scientists in other fields, and conduct cross-platform comparisons. Future

research should also survey or interview audience members whose interpretations are shaped by their experiences, identities, and values. Future research should also extend this study to assess the frequency of the codes and themes through content analysis. Future research also could extend this study to assess when codes and themes appear together through thematic co-occurrence analysis [Scharp, 2021], which would provide additional richness in understanding how topics and frames overlap. Despite these limitations, our study provided an exploratory look at strategic social media science communication. Researchers and practitioners focused on application should consider incorporating our findings into scientist communication training programs to assess how this understanding of strategic social media science communication holds up in training scientists.

5 - Conclusion

This study investigated how three women astronaut SIs acted as strategic social media science communication influencers. Findings show that these SIs utilize framing to strategically connect with diverse audiences on Instagram. Through their choice of topics or issues, message frames, and communication tactics, these women astronaut SIs share content to disseminate engaging scientific content in ways likely to broaden their reach and grow their audiences. Theoretically, we examine framing as an important communication objective for strategic social media science communication. Practically, this research provides valuable insights on how science communicators can communicate strategically on social media. As social media platforms continue to grow, these findings lend useful strategies for reaching new and diverse audiences to promote widespread public engagement with science.

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Data availability

The data analysed in this project are all publicly available Instagram posts posted by public figures. Data are available upon request from the corresponding author.

A - Supplemental theme exemplars

Table 1. Supplemental theme exemplars.

<i>Astronaut</i>	<i>Post summary</i>	<i>Post URL</i>
<i>Topics</i>		
<i>Share experiences and showcase contributions in STEMM</i>		
Kellie Gerardi	A video shows Gerardi exploring NASA's plant lab, highlighting the contributions the lab is making for growing plants in partial gravity.	https://www.instagram.com/reel/C_bnaTAO2LL/
Shawna Pandya	A video shows Pandya celebrating the first private spacewalk in SpaceX EVA suits. She states the moment captures both "the potential and fragility of the human species".	https://www.instagram.com/reel/C_3P3HjRfW9/
Norah Patten	A video shows Patten and Pandya practicing IUD insertion on a model of a uterus in microgravity.	https://www.instagram.com/reel/DA1MJXaMgMC/
<i>"I am a woman in STEMM"</i>		
Kellie Gerardi	Gerardi shares a video detailing the challenges of being a mother and astronaut. She shows a picture of her daughter that she keeps on her flight suit and explains in her caption the conversations she has with her daughter about why she has to miss milestones, like the first day of school.	https://www.instagram.com/reel/C-u6HjYOGKW/
Shawna Pandya	A slow-motion video of Pandya standing in front of the private jet used for parabolic flights in her flight suit flipping her hair back set to Rayelle's "Yes Yes I Can" and encouraging readers through the post's caption to go after their dreams.	https://www.instagram.com/reel/C_cZUUpX1XO/
Norah Patten	A collab post with Patten and Ireland AM, an Irish day time talk show, with Patten explaining what the space flight involves and encouraging other women to follow in her footsteps as a woman in STEMM.	https://www.instagram.com/reel/C87G5vgIdeR/
<i>Road to STEMM</i>		
Kellie Gerardi	Video shows Gerardi modelling a dress sewn by an elementary-aged girl who created a Barbie-sized version of the dress for a "Miss Solar System" science project that featured Barbie dolls representing different planets competing in different dresses she had sewed. Gerardi praises and tells her that she is so good at so many things, and she hopes she knows that she never has to choose.	https://www.instagram.com/reel/C-ymyhbuh1O/
Shawna Pandya	Video shows Pandya outside the front door of a house or townhouse as she offers career advice about two attributes that can be absolute team-killers. She discusses what strategies can be used when faced by this workplace scenario to ultimately succeed as a professional.	https://www.instagram.com/reel/C_zH1SpvJ6Z/
Norah Patten	Video shows closeups of a childhood art project collage that features images and photos of spacecraft and astronauts, noting a fascination with space at a young age that increased after trips to NASA as a teenager.	https://www.instagram.com/reel/C9Mk1snMKCg/
<i>STEMM spokesperson</i>		
Kellie Gerardi	A video shows Gerardi doing an interview with TJ Maxx, discussing what it's like being a woman in a male-dominated field.	https://www.instagram.com/reel/C-YpOOwvJME/
Shawna Pandya	A carousel of still images showcases Pandya's talk at the University of Alberta. She discussed her space medicine research and hoped to inspire future generations of astronauts.	https://www.instagram.com/p/DANRR6TR8T6/?img_index=1

Continued on the next page.

<i>Astronaut</i>	<i>Post summary</i>	<i>Post URL</i>
Norah Patten	A video shows Patten and Pandya at a meet and greet for the Norah Patten Foundation. The foundation provides education and outreach related to space research.	https://www.instagram.com/reel/DCuhma6M_Ii/
<i>#LIFE</i>		
Kellie Gerardi	A carousel of photos show and text describes Gerardi's emotional journey with pregnancy loss and IVF.	https://www.instagram.com/p/DA3qomGunz9/
Shawna Pandya	A carousel of still images show Pandya's pet bird, Jules, at the vet.	https://www.instagram.com/p/C_5tyJxRqjI/?img_index=5
Norah Patten	Video carousel shows video of her at the airport and sightseeing with her mom during a professional trip to Aix-en-Provence, France.	https://www.instagram.com/reel/C9Cup57sy8y/
<i>#Influencer</i>		
Kellie Gerardi	A video clip of Gerardi and her daughter Delta walking through the airport on their way to New York Fashion Week, lip syncing to Britney Spears's "Lucky" and noting that Delta is missing her first-grade spelling quiz because of their joint appearance in NYFW.	https://www.instagram.com/reel/C_srQahuekm/
Shawna Pandya	A clip of Pandya acting out a skit about her busy travel schedule and joking that her ability to sleep throughout multiple time zone shifts comes from her work as an ER doctor	https://www.instagram.com/reel/DCTOEYJO_YG/
Norah Patten	Patten shares a collection of artwork she created in 1999 showcasing her passion for space from an early age set to The Script's "Superheroes" and ties it into an update about a space launch scheduled for the day she posted the video	https://www.instagram.com/reel/C9Mk1snMKCg/
<i>Intentions</i>		
<i>"Get to know me"</i>		
Kellie Gerardi	A carousel of still images highlights a "career shower" Gerardi's mother threw her after the announcement of her second space mission. The images include cookies detailing parts of Gerardi's life, such as friendship bracelets, family, and astronaut number.	https://www.instagram.com/p/C9Pt7q4uZzs/
Shawna Pandya	A carousel of still images highlighting a recent trip to New York City. The post includes snapshots of Brooklyn, a concert, and the Harvard Club.	https://www.instagram.com/p/DAEvgZsSIT5/?img_index=1
Norah Patten	A carousel of still images showing Patten as a child visiting the Kennedy Space Center with her family.	https://www.instagram.com/p/C-Ii4TQMSEo/?img_index=1
<i>Celebrate STEMM wins</i>		
Kellie Gerardi	A video of Gerardi showing her collection of Barbie dolls in various careers and sharing how she's achieved milestones related to the various Barbies, including fashion designer, astronaut, White House, and love to read Barbies, with clips of her involved in the related activities.	https://www.instagram.com/reel/C-5MLm4OYex/
Shawna Pandya	A video clip of Pandya involves her doing a "Q&A" as herself and modelling someone else asking what she is doing and showing herself adding an astronaut parking sticker on top of her physician parking reserved spot.	https://www.instagram.com/reel/C9eLqrgRHf_/
Norah Patten	A video of Patten in her space suit floating during a parabolic flight set to Channel 86's "Clocks" featuring Marc Scibilia with a nod to an Instagram trend about practicing a soft smile.	https://www.instagram.com/reel/C-1_L9asS3b/

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<i>Astronaut</i>	<i>Post summary</i>	<i>Post URL</i>
<i>Stomp STEMM stereotypes</i>		
Kellie Gerardi	A video shows Gerardi during an interview with TJ Maxx sharing a story of how perceptions of astronauts have changed in her family. Focusing on generational changes in STEMM stereotypes, she explains that when she is asked to close her eyes and picture an astronaut, she pictures a man, even though she has done the work of an astronaut, but when her 6-year-old daughter is asked she draws a girl or herself.	https://www.instagram.com/reel/C-YpOOwvJME/
Shawna Pandya	A carousel switches from video clips of Pandya using hand gestures as the carousel switches to still photos featuring the women astronauts together in uniform or photos that highlight accomplishments of individual members of the team.	https://www.instagram.com/reel/C9AWtezpdOW/
Norah Patten	A video features the entire team of women astronauts in flight suits during a training session, smiling as they demonstrate removal of an IUD from a uterine model in zero gravity.	https://www.instagram.com/reel/DChQfcys67c/
<i>Open doors to STEMM</i>		
Kellie Gerardi	A video set to Angela Duckworth's "Grit" quote. The video contains clips of Gerardi in her space suit, performing experiments, in zero gravity, and being supported by friends and loved ones.	https://www.instagram.com/reel/C-ShSWLOo1Q/
Shawna Pandya	A still image of Pandya with Canada's Minister of Innovation, Science and Industry, Canada's President, and a Canadian Astronaut. The caption praises these Canadians' contributions to space research, highlighting how they inspire her and future generations.	https://www.instagram.com/p/DASJOTGxJxM/
Norah Patten	A video set to <i>Childhood Dreams</i> by Seraphine. The video contains clips of Patten next to the plane and in parabolic flight. The caption asks for questions she can answer regarding "behind the scenes" space research.	https://www.instagram.com/reel/C96tp6Qs3yk/
<i>Showcase team @virgingalactic #spaceteam</i>		
Kellie Gerardi	A video clip shows Gerardi lip-synching to audio about her being pregnant and her crew members lip-synching the second half of the audio to show the team's support for Gerardi's IVF journey.	https://www.instagram.com/reel/C-nM4z_O1l-/
Shawna Pandya	A video clip of the team floating during a parabolic flight practice with Pandya's audio relating to an Instagram trend of being "very demure, very mindful".	https://www.instagram.com/reel/C_YUv-mvaGO/
Norah Patten	A collab post between Patten and Pandya showcasing all three members of the team practicing an IUD removal on a model during a parabolic flight with Cobrah's "Feminine Energy" playing.	https://www.instagram.com/reel/DChQfcys67c/
<i>Share knowledge</i>		
Kellie Gerardi	A video carousel features Gerardi dressed in a bright teal lab coat and purple gloves, smiling as she gives a tour of NASA's Plant Lab and describes the importance of some of the experiments for advancing plant research in space.	https://www.instagram.com/reel/C_bnaTAO2LL/
Shawna Pandya	A video shows Pandya providing a brief overview in front of an airplane where she will join a team to conduct research on neuroscience, women's health, and clinic care ultrasound.	https://www.instagram.com/reel/C_GN-faRhBE/
Norah Patten	A video carousel shows scenes of Patten testing a spacesuit during a training session.	https://www.instagram.com/reel/C-K6sq_McYI/

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<i>Astronaut</i>	<i>Post summary</i>	<i>Post URL</i>
<i>Display home pride</i>		
Kellie Gerardi	A video of Gerardi answering messages after a storm in Florida. She mentions that she is “proud to be from the Sunshine State”.	https://www.instagram.com/reel/DA9DIzSWtz/
Shawna Pandya	A still image of Pandya in a space suit in parabolic flight. A Canadian flag floats in front of her. The caption reads “Happy Canada Day, wherever you are!”	https://www.instagram.com/p/C84nfRLJd4/
Norah Patten	A video shows an interview between Patten and Patrick Kielty on the <i>Late Late Show</i> . The interview details how Patten feels the weight of the Irish flag as she is the first Irish astronaut.	https://www.instagram.com/reel/DBBHbY_K2CG/
<i>Tactics</i>		
<i>Post format</i>		
Kellie Gerardi	A video clip of Gerardi from her first space flight looking down at the earth and saying, “Hi Delta”, set to The Fray’s “How to Save a Life”.	https://www.instagram.com/reel/DB6mviYOvio/
Shawna Pandya	A video compilation of clips from celebrity acceptance speeches thanking their mother with a still image of Pandya in her full space flight suit with her mother at the end.	https://www.instagram.com/reel/DCVhPZuudZ4/
Norah Patten	A collab post between Patten and the official Instagram account of Ireland showing a single photo of Patten with a headline about her upcoming space mission.	https://www.instagram.com/p/DBDotzWMX98/
<i>Standard Instagram features</i>		
Kellie Gerardi	A carousel of still images showing the space shower cookies Gerardi was treated to by her mother. The images have text on screen highlighting the connection of each cookie’s decoration to her work. In the caption, she provides additional information about her mother throwing her a space shower, tags the bakery, and uses hashtags and emojis.	https://www.instagram.com/p/C9Pt7q4uZzs/?img_index=2
Shawna Pandya	Pandya shares a video of her in front of a variety of screenshots sharing different comments she’s made over the years, with additional text on screen describing each comment. She summarizes the content in her caption and includes emojis and hashtags.	https://www.instagram.com/reel/DAkf7Mgxz_/
Norah Patten	A collab post between Patten, a nonprofit, and a podcast host showing a video clip from the podcast recording where Patten talks about how her former art teacher inspired her. In the caption, she expands on the encouragement she received from the teacher and includes emojis and hashtags.	https://www.instagram.com/reel/DBTJBfTMJCK/
<i>Instagram trends</i>		
Kellie Gerardi	A video of Gerardi and her Delta attending the Nickelodeon Kids Choice Awards. They reference popular culture by dressing in SpongeBob-themed attire. They reference viral Instagram trends by lip-synching to the Plankton Remix of <i>Pink Pony Club</i> by Chappel Roan.	https://www.instagram.com/reel/C9aGvs7p8C0/
Shawna Pandya	A video of Pandya comparing the Virgin Galactic space team to the Kardashians, referencing that they are a more iconic trio than the pop culture icons.	https://www.instagram.com/reel/C8v-D1ZOejx/
Norah Patten	A video showing Patten on an Irish beach in her flight suit and winter coat. She references popular culture by mentioning Taylor Swift in her caption and including Swift’s song, <i>Wildest Dreams</i> .	https://www.instagram.com/reel/C-F9BrAsY0r/

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Astronaut	Post summary	Post URL
<i>Humour/word play</i>		
Kellie Gerardi	Gerardi shares a comment criticizing her motherhood approach, then shares a variety of clips of her daughter taking part in various exciting experiences, such as meeting former President Biden, cheering on her mother at New York Fashion Week, and hugging her mom after a flight. Gerardi sets this to trending music and writes in the caption “Ah yes, Delta: a portrait of suffering...”	https://www.instagram.com/reel/C9VAGnoJQja/
Shawna Pandya	A video of Gerardi lip-synching to audio asking about how many times and responding more with text on screen asking how many times a day she thinks about space. In the caption, she comments, “That’s at least 2.88 times a minute for those keeping count...”	http://instagram.com/reel/D A2OeRdRghE/
Norah Patten	Patten responds to a video uploaded by another person, poking fun that she is “equally delicious” as the poster, harping on the initial poster’s tagline for his videos	https://www.instagram.com/reel/C99cFHAMDHY/
<i>Visual props</i>		
Kellie Gerardi	A video of Gerardi holding a pumpkin in one hand and a moon to another, offering them as if to another. She wears a blue sweater with stars and stands in front of artwork with planets and stars depicted. In the second clip, Gerardi holds a skeleton and wears her pink flight jacket.	https://www.instagram.com/reel/DayZ0YUuSVG/
Shawna Pandya	A slow-motion video of Pandya walking toward the private plane used for parabolic flights wearing her uniform.	https://www.instagram.com/reel/C-x1zgbvvPi/
Norah Patten	Patten shares a selection of clips standing in front of the plane used for parabolic microgravity preparation flights and a clip taken while floating during a parabolic flight while also floating a scientific instrument in her flight uniform.	https://www.instagram.com/reel/C-aFcE1MdEp/

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