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Strategic communication at the European Space Agency: juxtaposing strategy and public attitudes

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Abstract

This case study analyses the efficacy of the European Space Agency's (ESA) strategic communication through a content analysis and an online attitudes survey in Germany. Our findings generally indicate low efficacy as ESA's communication strategy strongly focusses on press agentry, and is not managed in a sufficiently strategic manner. ESA pays little attention to evaluation and lays emphasis on targeting 'the general public'. By contrast, we reveal a diversity of attitudes towards ESA among various publics. In light of this disconnect from best practice and public attitudes, we argue for a more inclusive approach which maximises public participation and introduces a more diverse and evidence-based science communication portfolio so as to make ESA's communication more efficacious and sustainable.

Keywords

Participation and science governance; Public engagement with science and technology; Public perception of science and technology

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Introduction

For publicly funded organisations, it is often a basic funding requirement to continuously legitimise their expenditures by means of institutional communication. When it comes to organisations managing or carrying out research and innovation (R&I), communication emphasising engagement between academic, industry, policy and civil society stakeholders in a "quadruple helix" knowledge system [Carayannis & Campbell, 2009] can help research and innovation (R&I) deliver sustainable impacts. Managing these stakeholder relationships is usually the task of the organisational communication function generally known as public relations (PR) — despite the negative connotations this term might have. Particularly in science PR, trust is an essential component for long-term and mutually beneficial outcomes [Borchelt & Nielsen, 2014].

1.1 Science PR

Naturally, science PR is the application of conventional PR in the scientific context. In fact, there are clear parallels between PR and science communication theory in themselves. The work by J. E. Grunig and Hunt [1984, p. 22] on the four basic paradigms of PR represents a cornerstone in the PR field, where *two-way symmetrical* PR contributes best to long-term organisational effectiveness as it is "based on research and uses communication to enhance public participation [to] produce effects that balance [...] interests" [J. E. Grunig & Grunig, 2008, pp. 337–338]. A postmodernist take on the two-way symmetrical model suggests abolishing the notion of having to balance different positions [L'Etang, 2006, p. 366], thus enabling true symmetry by working towards exploring common interests instead. It is important to note that while scientific organisations should lay emphasis on public participation and two-way symmetrical PR, they may adopt mixed approaches, where different communication models serve different purposes that jointly contribute to the organisations' effectiveness [Bucchi & Trench, 2014; J. E. Grunig & Grunig, 1992; Metcalfe, 2014; Trench, 2008]. Consequently, marketing and other asymmetrical means are hardly obsolete, and should continue to be solid components of (science) PR, as characterised by Hutton [2001].

1.2 Strategic communication

Current understandings of PR [e.g., Corbett, 2012] clearly give the communication function a strategic management role with an ethical and socially responsible purpose. Chaffee [1985] describes three major types of strategy: *linear strategy* (strict planning and implementation), *adaptive strategy* (adaptation to the environment), and *interpretive strategy* (co-developing goals), where the latter is centred around complex relationships and communication. As such, the communication function is indirectly assigned the purpose of building socially responsible relationships [Kendall, 1995] — in line with a two-way symmetrical focus. Social responsibility and public participation in the form of 'corporate community' [Halal, 2000] have also been mentioned in the context of strategic communication [Steyn, 2003]. The work by Ströh [2007] is particularly supportive of an approach to strategic communication which enables engagement and participation in its design. In this sense, Cornelissen [2017] makes a case for corporate communication in which the communication and corporate strategies are integrated as two components of the same planning process. Indeed, L. A. Grunig, Grunig and Ehling [1992, p. 86] concluded in their empirical work that "[p]ublic relations contributes to organizational effectiveness when it helps reconcile the organization's goals with the expectations of its strategic constituencies".

Participation — whether integrated in the strategic design phase or not — requires research. Generally, there is widespread consensus that systematic evaluation is essential for strategic communication [e.g., Broom & Sha, 2012; Guth & Marsh, 2017; Smith, 2020] as it can enable evidence-based decision-making so as to maximise the effectiveness of science communication [Jensen & Gerber, 2020]. Gertler, Martinez, Premand, Rawlings and Vermeersch [2016, p. 20] even consider a lack of evaluation in itself unethical conduct. The evaluation of communication can consist of an ex-ante phase [see Neresini & Pellegrini, 2014; Storksdieck & Falk,

2004] including stakeholder analysis [see Hovland, 2005; Mendizabal, 2010], in itinere, and ex-post evaluation [e.g., Neresini & Pellegrini, 2014].

In terms of scope, much of the literature supports the distinction between (grand) strategy as a general rationale and tactics as means to implement the strategy [Bentele & Nothhaft, 2014; Botan, 2006; Broom & Sha, 2012; Smith, 2020]. Here, goals and objectives are crucial components of communication strategy, where the former describes ultimately desired achievements guided by current issues to be addressed through communication, while the latter are concrete objectives ideally following the SMART-criteria (i.e. specific, measurable, achievable, relevant, and time-bound) [for the original S.M.A.R.T. criteria see Doran, 1981; for the current definition see Frost & Boos, 2002]. Tibbie [1997, p. 357] believes that despite the abundance of organisational communication strategies, "[v]ery few [...] would really qualify as such" as they misrepresent the concept of strategy.
In communication, strategy is the means of ensuring efficacy (that is, defining the right communication approaches to be able to achieve the desired outcomes or goals). Conceptually misrepresenting strategy therefore means risking low efficacy.

1.3 Strategic space communication

Circling back to scientific organisations, the efficacy of *science* PR is particularly relevant if we consider effective science communication essential in the face of numerous global crises in a post-normal era. Arguably, this is especially true for the space sector. Major space agencies such as the National Aeronautics and Space Administration (NASA) or the European Space Agency (ESA) are often put in the spotlight as facilitators and performers of cutting-edge R&I activities with important implications for a wide range of stakeholders. At the same time, space activities can be particularly attractive for science communication as they easily captivate audiences and serve as a gateway for getting people enthusiastic about science [Madsen & West, 2003].

Although the efficacy of organisational communication strategies has not explicitly been studied in the context of the space sector (or any other sector for that matter), an expert panel to improve NASA's public communication touched on some strategic aspects. They identified predominantly asymmetrical approaches as well as a "general lack of intellectual rigor applied to [...] communication activities, especially as contrasted with the very rigorous scientific environment in which this communication arises" [Borchelt, 2001, p. 200]. In the same work, Borchelt also advocates for "a diverse science communication portfolio" that goes beyond publicity and information dissemination [p. 208]. Indeed, Nielsen, Jørgensen, Jantzen and Christensen [2007] highlight credibility issues in astronomy communication, "most often caused by an intense need for visibility" [p. 7].
By contrast, space communication efforts focussing on public engagement and co-creation are seen as particularly effective [Sandu, 2014].

In Europe, ESA was founded as an international organisation to independently access space and enable collaborative R&I among member states and associated states [European Space Agency, 2019a, pp. 13–14]. ESA is now among the largest space agencies on Earth, with a diverse range of independent and inter-agency activities that have far-reaching socio-economic and environmental implications

[e.g., Bryła, 2018; Euroconsult, 2019; PwC, 2019a, 2019b]. As such, ESA has a responsibility towards a range of stakeholders that reaches beyond legitimising the expenditure of public funds [e.g., Gehman, Lefsrud & Fast, 2017]. Whether the Agency's communication does its responsibility justice depends on its strategic approach to communication and whether it sufficiently addresses stakeholders' needs and attitudes [Dare, Schirmer & Vanclay, 2014; Harrison & St John, 1998]. Herein, particular attention should be paid to their largest stakeholder group, the general public. The relevant body of literature on public attitudes towards European space activities covers general public perceptions of space activities [TNS Opinion & Social, 2014] and attitudes towards space science in particular [Institute for Methods Innovation, 2019]. However, there is no systematic work on attitudes towards ESA as an organisation nor on attitudes towards a more diverse range of space activities.

In this paper, we assess the efficacy of ESA's communication by analysing its communication strategy and juxtaposing it with public attitudes towards the Agency and best practice. We answer the following research questions:

1. What are the characteristics of ESA's communication strategy, according to PR and strategic communication theory?
2. What is the attitudinal landscape towards ESA and European space activities among different socio-demographic groups?
3. To what extent does ESA's communication strategy follow best practice and address public attitudes and their inherent level of diversity?

Specifically, we analysed ESA's 3-year Communication Strategy for the 2018–2020 period with a mixed methods approach. This included a content analysis examining ESA's communication function on a strategic level, and a cross-sectional online survey looking into attitudes towards ESA and European space activities. Both research strands were used to identify potential discrepancies a) between ESA's communication strategy and best practice (as laid out in the literature), and b) between ESA's communication strategy and public attitudes towards the Agency and European space activities.

Methods

2.1 Content analysis

ESA's communication strategy was assessed through a content analysis of all available documents on the matter. The documents were collected through confidential communication with ESA staff and by reviewing all official and publicly available information related to the Agency's communication. The main 2018–2020 Communication Strategy document [European Space Agency, 2017b] represents the heart piece and most detailed account of ESA's communication framework, accompanied by presentation slides about the Communication Strategy [European Space Agency, 2017a]. The 2018 communication report [European Space Agency Council, 2018] is a conceptual and practical review of ESA's strategic communication for said year with relevant amendments to the strategy. ESA's webpage about the Communication Department [European Space

Agency, n.d.-a], as well as ESA's webpage about its PR (at the European Astronaut Centre) [European Space Agency, n.d.-b] were less comprehensive though contained the only publicly available information on the Agency's communication and communication function. To the knowledge of the ESA staff we communicated with, the list of confidential documents relevant to ESA's strategic communication was exhaustive. All documents were analysed as formal manifestos of ESA's strategic communication framework. A deductive approach was chosen based on established concepts from the PR and strategic communication literature.

In an initial step, we segmented the documents into single paragraphs and filtered out irrelevant sections by conducting an initial screening. Content was considered irrelevant if it did not contain or reference at least one PR or strategic communication concept. If a paragraph contained multiple relevant content segments, the paragraph was split so that each relevant content segment could be coded individually. Individual content segments containing relevant data are hereinafter referred to as 'items'. The following item categories were included: *communication issue* (as in, issues or trends to be addressed by the communication function; see Steyn [2003]), *stakeholder* [see Freeman, 1984], *evaluation means* (includes the general indication of intent or specific steps to evaluate), *communication goal* (rather vague, ultimately desired achievement), *communication objective* (more specific, ideally following the SMART criteria [Frost & Boos, 2002]), and *communication tactic/activity* (one or more concrete output-oriented activities). Coding for either of the above categories led to subsequent sub-coding for more detailed analyses.

From a preliminary scan of the strategic documents, it became evident that tactics/activities would take up a disproportionately large share of the documents' contents. As tactics and single activities are strictly speaking not part of communication strategy, they were included in the content analysis as one separate, collapsed item type in order to ascertain the extent to which non-strategic items were incorporated into ESA's communication strategy. Regardless of whether tactics and activities are truly strategic, they were explicitly *treated* as strategic by ESA's Communication Department. Therefore, an additional reason for including this item type was a more accurate ascertainment of their strategic PR approach than merely looking at goals and objectives.

Two independent research assistants performed the coding, and the Krippendorff coefficient α_K for intercoder reliability [Krippendorff, 2019] was calculated using the Python implementation by Grill and Castro [2017]. After three rounds of quality checks, including briefings, test-coding, de-briefings, and amendments to the codebook, a final mean intercoder reliability was achieved above the .80 threshold defined by Krippendorff [2019], $\alpha_K = .87$. An intercoder reliability slightly under .80 was calculated for three out of 13 categories: $\alpha_K = .74$, $\alpha_K = .78$, and $\alpha_K = .79$. Both coders analysed the complete dataset.

2.2 *Public survey*

The survey protocol described hereinafter was fully approved by the Ethics Commission of the Sigmund Freud University.

2.2.1 Survey design

In addition to the content analysis, an online survey was employed to assess publics' knowledge, attitudes and (hypothetical) behaviours (for the purposes of this study, 'publics' will hereinafter refer to the plurality of socio-demographic groups making up what may generally be known as 'the general public').
The survey design is available in the repository linked at the bottom of this paper. The questionnaire was compatible with various computers and mobile devices. The survey was designed and carried out in German.

As awareness of ESA could not be expected from all members of the population, limited attitude accessibility [see Fazio, Chen, McDonel & Sherman, 1982] and object-evaluation association [Fazio, 2007] needed to be considered in the survey design. Thus, in order to facilitate attitude retrieval or attitude formation, a filter was employed to redirect participants who had not known of ESA to questions that did not directly reference the ESA brand.

All attitudinal survey items used 101-point semantic differentials with sliders for value submission. Both poles and the middle value on the scale were labelled. Additionally, the value was constantly and interactively displayed while sliding. To avoid any bias from prepositioning the slider on a certain value, the sliders themselves were set invisible until participants initiated their response submission. Where applicable, survey items were alternately reverse-coded to minimise acquiescence bias, and the order of items was randomised within their blocks.

Two pilot tests and adjustments were conducted. For the first pilot test, six participants were asked to fill out the questionnaire in the presence of a researcher while verbally explaining their thought process throughout their participation. The final pilot test was conducted explicitly online with 18 geographically more diverse participants who were asked to comment on the questions in comment boxes incorporated into the online form.

2.2.2 Sampling & data management

As a compromise due to resource constraints, the target population was limited to German residents, ESA's largest monetary contributor and largest national stakeholder group [European Space Agency, 2019b]. Hence, data collection targeted German residents aged 16 and older, and was conducted from 11 February 2020 to 1 March 2020. This was done as part of an academic thesis [Pfleger, 2020]. Due to the same resource constraints, convenience sampling and snowball sampling were employed over email, social media and messaging platforms including Facebook, Instagram, Twitter, LinkedIn, and WhatsApp. Despite the limitations of this sampling approach, a total of 716 unique survey entries were collected. The survey data was subsequently cleaned by applying inclusion criteria, only considering cases as valid if they contained non-missing data for the variables *gender*, *age*, *state of residence*, *level of education*, and *occupation*. Based on the latest German census [Statistische Ämter des Bundes und der Länder, 2011], the survey data was weighted to represent the German population more accurately. The final sample size post-cleaning was $N = 481$ ($\hat{p}_{\text{woman}} = 50\%$, $M_{\text{age}} = 46.5$, SD $= 18.8$ [weighted]). Although the sample was greatly improved, the non-probabilistic sampling could obviously not result in highly representative results.

Missing data in the online questionnaire were dealt with through multiple imputation as Little's MCAR test indicated the data were missing at random, $\chi^2(255) = 251.793$, $p = .545$. Overall, only 6.4% of all valid cases contained missing data, and just 0.6% of all values were missing. Five imputations were done using a linear regression model. All results presented below are pooled results.

Trust scores were computed with the mean of all trust items. Composite variables were computed with the *boredom/excitement* and *redundancy/necessity* items, respectively.

2.2.3 Data analysis

Apart from descriptive statistics, a series of inferential analyses were performed: Chi-squared tests for nominal dependent (DV) and independent (IV) variables; t-tests and one-way ANOVA for interval DVs and nominal IVs, Pearson correlations for interval DVs and IVs; Mann-Whitney U and Kruskal-Wallis tests for ordinal DVs and nominal IVs; and Kendall's tau-c for ordinal DVs and IVs as well as for highly skewed interval DVs. Post-hoc pairwise comparisons were done for ANOVA and Kruskal-Wallis tests with Bonferroni corrections. Dunnett T3 multiple comparison tests were conducted for ANOVA due to largely unequal variances, and only significant effects with a margin of error of ± 5 and a mean difference of above 15 were considered noteworthy. Throughout this paper, results with at least moderate effect sizes are referred to as 'noteworthy'. Two-tailed tests were performed. Statistically significant findings were reported at $\alpha < .05$.

To obtain a knowledge score for each participant, a content analysis was performed to analyse the open-ended responses to the question on knowledge about ESA. A codebook was drafted based on a database of ESA space missions and activities. A response was considered correct if it mentioned an ESA space mission or activity (e.g., "planetary defence (HERA)" or "construction and operation of launch vehicles"). Responses such as "unmanned space flight" or "experiments under space conditions" were coded as *Ambiguous* due to a lack of specificity or because it was unclear whether the respondent meant an actual ESA space mission or activity. Incorrect entries or entries not explicitly describing an activity did not receive any points (e.g., "construction of moon base" or "meteorites"). The final analysis delivered a Krippendorff's alpha above the threshold [Krippendorff, 2019], $\alpha_K = .89$. This was based on a randomised subsample of 12% of all the data, coded by both research assistants. Each participant received one point (1) for each correct response, and responses coded as *Ambiguous* were awarded half a point (0.5). The sum of each participant's points resulted in their individual knowledge score.

Results

3.1 Content analysis

3.1.1 Communication issues

ESA's strategic communication was oriented around various issues which affect ESA as an organisation, and which could be addressed through communication. Table 1 shows the degree to which different types of communication issues were represented in the communication strategy. One of the largest types of issues the

Table 1. Representation of communication issues in ESA's communication strategy.

Context	n	$\hat{p}$
Uncertain	1	11%
Space sector	3	33%
Media	3	33%
Civil society	2	22%
Government/policy	0	0%
Environment	0	0%
Total	9	100%

Table 2. Representation of communication management positions ESA assumes.

Communication management position	n	$\hat{p}$
Uncertain	0	0%
Corporate self-management	9	100%
External context management	0	0%
Two-way stakeholder management	0	0%
Total	9	100%

communication strategy seemed to be concerned with were changes in the *space sector*, 33%, $n = 3$; e.g., the increasing privatisation of the space sector: "private sector companies [...] are today [...] serious actors and competitors". ESA also stated that it must "take its role as THE European Space Agency", implying the perceived need to increase ESA's relevance in the European space sector.

Another major proportion of issues was related to the *media* landscape and *civil society*, 55%, $n = 5$. They mainly focussed on "the way we access digital content" and how this has changed (i.e., on social media, using mobile devices).

The next step was assessing the role ESA assumed in the context of individual communication issues. The coding categories included *corporate self-management* and *external context management* [Hoffjann & Hachmeister, 2016], but also two-way stakeholder management as a symmetrical option (see Table 2). The strategic communication documents exclusively indicated self-management, 100%, $n = 9$. In other words, solely ESA ought to adapt to address the communication issues. This was evident from explicit or latent content such as "ESA [...] must change to meet new expectations and new challenges", and "we must [...] work to ensure our voice is heard".

3.1.2 Communication evaluation

The degree to which ESA incorporated evaluation was analysed next (see Table 3). Items categorised as *ex-ante* evaluation made up 8%, $n = 5$, of all items about evaluation, e.g., the plan to "assess [...] proactive and reactive partnership opportunities". Items such as "number of established partnerships" indicating in itinere evaluation made up the majority, 82%, $n = 49$. The number of *ex post* evaluation items such as "Key Performance Indicator in terms of [...] ESA brand awareness" was comparatively small, 7%, $n = 4$.

Table 3. Representation of evaluation in ESA's communication strategy.

Evaluation type	*n*	$\hat{p}$
Uncertain	2	3%
Ex-ante	5	8%
In itinere	49	82%
Ex-post	4	7%
Total	60	100%

Table 4. Representation of different levels of specificity inherent in strategic content related to evaluation.

Item specificity	*n*	$\hat{p}$
Uncertain	0	0%
Vague/platitude/virtue-signalling	24	40%
Concept	16	27%
Indicator	5	8%
Variable	15	25%
Total	60	100%

Table 4 shows the level of specificity regarding mentions of, or references to, evaluation in the communication strategy. The largest proportion of items about evaluation were rather vague statements, platitudes, and virtue-signalling content, 40%, $n = 24$. This means that most of the content on evaluation did not indicate specific evaluation means but mentioned evaluation in a vague manner or indicated the benefits of evaluation. For instance, ESA stated that the "measurement and evaluation of how ESA is performing in Communication is fundamental to help focus efforts and ensure that resources are invested in the most efficient way", without indicating whether or how they actually planned to evaluate their communication.

Furthermore, the majority of more specific evaluation items (i.e., those involving *indicators* or *variables*, in sum 33%, $n = 20$) was related to measuring *outputs*, 70%, $n = 14$, as opposed to *outcomes*, 25%, $n = 5$. "Key Performance Indicator in terms of [...] content on ESA channels" and "Key Performance Indicator in terms of [...] ESA brand awareness" are examples for output- and outcome-related items, respectively. This distribution suggests a strong focus on output-oriented evaluation instead of impact evaluation.

3.1.3 Stakeholders

All items mentioning stakeholders were considered in the content analysis as well. Certain stakeholders were explicitly listed in these documents and labelled either as "audiences" or "customers", whereas mentions of other stakeholders were scattered across the documents' continuous text. The Communication Department defined *customers* as mainly internal stakeholders with management positions (e.g., ESA Directors) who have the need of communicating certain messages to certain *audiences* (e.g., the general public). Here, the Communication Department described its own role as a service provider that delivers messages to audiences on behalf of its customers [European Space Agency, 2017a].

Table 5. Representation of stakeholder labels in ESA's communication strategy.

Stakeholder label	n	$\hat{p}$
No label	54	75%
Audience	10	14%
Customer	8	11%
Total	72	100%

Only 25%, $n = 18$, of all the stakeholders who were mentioned in the documents were included in ESA's audience/customer list. Of those, 56%, $n = 10$, were labelled as audiences and 44%, $n = 8$, were labelled as customers (see Table 5). In line with ESA Communication's own definition of 'customer', a large majority of stakeholders labelled as such were coded as internal decision-making stakeholders, 63%, $n = 5$.

Most of the stakeholders mentioned in ESA's communication documents were not listed, labelled, or categorised systematically, 75%, $n = 54$. Additionally, many of the stakeholders without labels were similar yet distinctive variations of one another. For instance, there were many variations of "partners", among which it is unclear whether there is any or even full overlap: "branded partners", "institutional partners", "commercial partners", "new partners", "non-space partners", and "non-traditional partners".

When it comes to the level of specificity regarding stakeholders, the strategy mainly referred to *stakeholder groups* or *multiple stakeholder groups*, 78%, $n = 56$, where the "general public" was mentioned most frequently (32 times) across all documents. Other than "younger generations" (mentioned 6 times), there was no differentiation of publics.

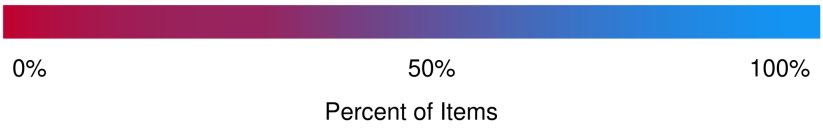
3.1.4 Communication goals, objectives, tactics, and activities

Regarding communication *goals*, *objectives* and *tactics/activities*, items were dispersed throughout different documents and rarely clearly or consistently defined. In fact, the concepts were used interchangeably as nearly two thirds of all items were labelled incorrectly, 63%, $n = 15$. For instance, ESA's "goal to get the attention of [their] core audience" would be better suited as an objective, albeit not fulfilling the SMART criteria [see Frost & Boos, 2002]. Nearly half of all identified communication goals and objectives were not labelled at all, 46%, $n = 6$. Additionally, goals and objectives only made up 15%, $n = 13$, of all items in this section, in contrast to tactics and activities representing the majority of the content in the strategy documents, 85%, $n = 73$.

The underlying PR model in ESA's communication was ascertained by coding for subcategories which were based on the fundamental paradigms laid out by J. E. Grunig and Hunt [1984] [see also J. E. Grunig, 1984]. Table 6 shows a heat map summarising all PR characteristics and their representation in ESA's strategic communication documents. ESA's Communication Department established "main principles" to guide their communication, which were all centred around content production and media relations. They included the "need to [...] make the content [they] provide more compelling" because "[the general public] need to understand

Table 6. Adapted heat-mapped table of PR paradigms according to J. E. Grunig and Hunt [1984] and J. E. Grunig [1984]. The colour in each cell corresponds to the proportion by which ESA's strategic communication represents the coded items. The colour saturation is heavily polarised as the cells are either very scarcely or very strongly represented.

Characteristic	Press Agentry/Publicity	Public Information	Two-Way Asymmetrical	Two-Way Symmetrical
Purpose	Propaganda	Information Dissemination	Persuasion	Mutual Understanding
PR-Contribution	Advocacy	Information Dissemination	Advocacy	Mediation
Nature of Communication	One-Way; Complete Truth not Essential	One-Way; Truth Important	Two-Way; Imbalanced Effects	Two-Way; Balanced Effects
Communication Model	Sender-Receiver	Sender-Receiver	Sender-Receiver with Feedback	Group-Group



ESA's role and be supportive of it". They also accentuated the importance of "mak[ing] sure ESA is perceived as a visionary, trustworthy, diverse, adaptive and agile organisation". As such, the overwhelming majority of items indicated *propaganda* as the purpose of ESA's PR (i.e., promoting the organisation, or 'spreading the word' about it), 91%, $n = 78$, *advocacy* as the PR-contribution to the corporate strategy, 92%, $n = 79$, *one-way communication* with exclusive disclosure of favourable information, 92%, $n = 79$, and the *sender-receiver* model of communication, 95%, $n = 82$. Overall, it is evident that ESA's PR approach overwhelmingly corresponds to the *press agentry/publicity* paradigm (one-way asymmetrical).

3.2 Public survey

Awareness of ESA was found to be 78%, 95% CI [.740, .821], although the level of knowledge about the Agency's space activities was generally low among those who had heard of ESA, Mdn = 1.00, Mode = 0. Trust in ESA was overall in the mid-positive range (see Table 7 for the descriptive summary of interval variables). Regarding the behavioural dimension, however, 8%, 95% CI [.055, .110], followed ESA on social media, and the frequency of actively searching for information about the Agency was low, Mdn = 1.00 (*not at all*) at 76%, 95% CI [.721, .805].

The other survey sections investigated attitudes towards European space activities without the cognitive link to the ESA brand specifically (see Table 7). In general, space activities were seen as useful, and people tended to agree to an even higher degree that "it is good that Europe has its own space agency". However, on the topic of public participation, a rather neutral score indicated uncertainty about whether it was possible for citizens to engage in space activities. Individuals also tended to evaluate space activities' influence on their personal lives as just slightly positive, while their influence on society at large and the economy were estimated as more positively.

Table 7. Descriptive summary of interval variables. The variable numbers in the leftmost column are to facilitate the identification of each variable across tables.

	Variable	*M*	*95% CI for M*		SD
			Lower	*Upper*	
1	Trust	22.22	20.44	24.01	15.93
2	Agreement: Space activities are useful	26.11	23.36	28.85	27.76
3	Agr.: It is good that Europe has its own space agency	32.62	30.50	34.75	21.52
4	Agr.: Civil society is able to engage in space activities	6.52	3.42	9.63	31.40
5	Negative/Positive: Influence of space act. on pers. life	11.76	9.72	13.79	20.58
6	Neg./Pos.: Influence of space activities on society	20.70	18.93	22.46	17.82
7	Neg./Pos.: Influence of space activities on the economy	17.62	15.62	19.61	20.14
8	Agr.: Spending of publ. money on space act. is desirable	28.16	25.86	30.47	23.28
9	Agr.: Space activities are inspiring	21.06	18.84	23.28	22.48
10	Agr.: Not worried about the risks of space activities	6.71	4.05	9.36	26.84
11	Redundant/Necessary: Space activities (composite)	31.74	30.22	33.25	15.27
12	Red./Nec.: Earth observation	43.79	42.40	45.19	14.12
13	Red./Nec.: Human and robotic exploration	22.63	19.93	25.32	27.28
14	Red./Nec.: Space transportation	22.25	19.88	24.63	24.01
15	Red./Nec.: Navigation	36.25	34.49	38.01	17.77
16	Red./Nec.: Space science	28.63	26.62	30.64	20.32
17	Red./Nec.: Technology, engineering and quality	26.31	24.47	28.16	18.62
18	Red./Nec.: Telecomm. and integrated applications	33.73	31.47	36.00	22.89
19	Red./Nec.: Space safety and security	36.99	35.01	38.98	20.07
20	Red./Nec.: Operations	35.03	33.28	36.78	17.69
21	Boring/Exciting: Space activities (composite)	22.42	20.49	24.34	19.47
22	Bor./Exc.: Earth observation	33.71	31.70	35.72	20.30
23	Bor./Exc.: Human and robotic exploration	17.75	15.40	20.10	23.74
24	Bor./Exc.: Space transportation	14.87	12.11	17.64	27.92
25	Bor./Exc.: Navigation	20.95	18.23	23.67	27.46
26	Bor./Exc.: Space science	31.44	29.48	33.40	19.85
27	Bor./Exc.: Technology, engineering and quality	22.34	19.96	24.72	24.09
28	Bor./Exc.: Telecomm. and integrated applications	20.31	17.88	22.73	24.51
29	Bor./Exc.: Space safety and security	25.28	23.09	27.46	22.08
30	Bor./Exc.: Operations	15.10	12.35	17.84	27.75

Regarding the affect dimension, the general expenditure of public money on space activities was seen as desirable rather than aggravating, and space activities were seen as inspiring overall, although to a more moderate extent. On the other hand, people tended to be divided about whether the risks space activities might bear are worrying.

Attitudes towards specific types of European space activities were overall positive. They were generally seen as quite necessary as opposed to redundant. *Earth observation* scored highest by a rather large margin, followed by *Space safety and security*, and *Navigation*. People also tended to indicate moderate excitement instead of boredom about these space activities. Again, *Earth observation* received the highest ratings, and *Space science* followed by a narrow margin.

Respondents were also asked about their financial commitment to ESA via tax in a hypothetical scenario where they could select their annual contributions. The most central value was Mdn = €50, although the most frequently selected amount was considerably lower, Mode = €10, with 20%, 95% CI [.16, .24] having indicated this value.

3.2.1 Socio-demographic predictors

Age. A number of attitudinal aspects seemed to be moderated by the factor age. While there were no noteworthy correlations with cognitive items, we identified a positive correlation with the knowledge score, $r_\tau = .39$, $p < .001$, $r^2 = .15$, and with trust in ESA, $r(393) = .39$, $p < .001$, $r^2 = .15$. The level of excitement about ESA space activities was also positively correlated with age, $r(393) = .37$, $p < .001$, $r^2 = .14$.

Gender. Gender played a major role in whether respondents were aware of ESA, $\chi^2(2) = 90.642$, $p < .001$, $V = .48$. Nearly all men knew about the Agency, 95% CI [.97, .99], compared to just above half of women, 95% CI [.53, .63].

Women generally had far more negative perceptions of ESA and space activities than men (see Table 8). Although there was agreement from both genders that "Europe having its own space agency is a good thing", the difference between women and men was large. On whether civil society was able to engage in space activities, women tended to respond slightly negatively, whereas men erred on the positive side. More moderate differences between women and men were observed on whether space activities are useful, whether space activities have a negative or positive influence on the economy, and whether ESA space activities are redundant or necessary.

Although both genders were positively inclined towards the expenditure of public funds for space activities, women were far less comfortable than men. Women also tended to worry slightly about the risks space activities might bear, $M = -6.35$, compared to men being rather unworried, $M = 19.87$. Excitement about ESA space activities was also subject to gender differences: Men's excitement rating was far higher. Women additionally found space activities less inspiring than men did.

There was also a difference in how much men were willing to annually contribute to ESA via tax compared to women. This willingness was moderately higher among men than it was among women, $U = 22721.000$, $p < .001$, $\eta^2 = .10$.

Residency. Participants' states of residence were collapsed into two main categories: states with an ESA establishment and states without an ESA establishment. There were only few noteworthy effects in this regard. There was a small significant relationship between respondents' awareness of ESA and whether they lived in a federal state with an ESA establishment, $\chi^2(2) = 14.030$, $p = .001$, $V = .18$. Similarly, there were negligible differences between residents in states with and without ESA establishments when it came to their knowledge about ESA, $U = 13580.500$, $p = .007$, $\eta^2 = .02$.

Table 8. Summary of gender differences in attitudes between women and men. Variable short names are given. For the full variable descriptions, see Table 2.

	Variable (short)	*t*	*df*	*p*	ΔM	*95% CI of* ΔM		*d*
						Lower	*Upper*	
1	Trust	−11.546	393	.000	−16.84	−19.70	−13.98	−1.01
2	Space activities useful	−7.162	393	.000	−18.84	−24.00	−13.68	−0.68
3	Own space agency	−9.087	388	.000	−17.90	−21.77	−14.04	−0.83
4	Able to engage	−10.074	388	.000	−28.43	−33.96	−22.90	−0.91
5	Influence on personal life	−4.475	303	.000	−9.08	−13.05	−5.10	−0.44
6	Influence on society	−4.045	363	.000	−7.13	−10.58	−3.67	−0.40
7	Influence on economy	−5.932	355	.000	−11.55	−15.35	−7.75	−0.57
8	Expenditure desirable	−8.823	393	.000	−18.91	−23.11	−14.71	−0.81
9	Space activities inspiring	−6.622	393	.000	−14.28	−18.50	−10.05	−0.64
10	Not worried about risks	−11.111	393	.000	−26.22	−28.58	−23.86	−0.98
11	R/N (composite)	−5.764	393	.000	−8.52	−11.42	−5.62	−0.56
12	R/N: EO	−0.353	393	.724	−0.50	−3.11	2.11	−0.04
13	R/N: HRE	−8.400	383	.000	−21.38	−26.37	−16.39	−0.78
14	R/N: ST	−7.762	368	.000	−17.52	−21.94	−13.09	−0.73
15	R/N: NAV	−2.517	392	.012	−4.47	−7.73	−1.21	−0.25
16	R/N: SCI	−5.722	391	.000	−11.31	−15.18	−7.43	−0.56
17	R/N: TEQ	−5.317	393	.000	−9.64	−11.45	−7.83	−0.52
18	R/N: COMM	−0.911	338	.362	−2.11	−6.64	2.43	−0.09
19	R/N: SEC	−2.433	393	.014	−4.88	−6.89	−2.88	−0.24
20	R/N: OPS	−2.764	365	.006	−4.89	−8.42	−1.35	−0.28
21	B/E (composite)	−11.890	362	.000	−20.03	−23.33	−16.73	−1.03
22	B/E: EO	−6.314	393	.000	−12.34	−16.17	−8.51	−0.61
23	B/E: HRE	−3.320	376	.001	−7.84	−12.46	−3.22	−0.33
24	B/E: ST	−11.220	393	.000	−27.48	−32.24	−22.71	−0.98
25	B/E: AV	−9.829	385	.000	−24.38	−29.25	−19.52	−0.89
26	B/E: SCI	−7.599	393	.000	−14.19	−17.84	−10.54	−0.71
27	B/E: TEQ	−9.675	383	.000	−21.13	−25.41	−16.85	−0.88
28	B/E: COMM	−10.968	366	.000	−23.72	−25.88	−21.56	−0.97
29	B/E: SEC	−10.646	393	.000	−20.90	−24.74	−17.05	−0.95
30	B/E: OPS	−11.750	393	.000	−28.26	−32.98	−23.55	−1.02

Education and occupation. People's knowledge score was somewhat dependent on the type of professional education, $H(6) = 48.573$, $p < .001$, $\eta^2 = .12$. People who held a diploma knew more about ESA than people without professional education and people with education categorised as *other*, $z = 4.591$, $p < .001$, $\eta^2 = .18$, and $z = 6.421$, $p < .001$, $\eta^2 = .12$.

Occupation also predicted attitudes towards ESA and space activities (see Table 9). Most effects were attributed to differences between employees and *Beamte* (i.e., people in civil service, such as teachers, public prosecutors, municipal clerks, or police officers; we will refer to this group as 'officials'). For instance, officials agreed to a larger extent than employees that "it is good that Europe has its own space agency". Employees also felt less comfortable with the expenditure of public funds for space activities than officials. Employees were, however, more at ease

Table 9. Summary of noteworthy pairwise comparisons from significant ANOVA results. $p < .001$ applies to all results. Variable short names are given. For the full variable descriptions, please see Table 2.

	Variable (short)	*Pairwise comparison*	F	η^2_{part}	ΔM	*95% CI of* ΔM	
						Lower	*Upper*
3	Own space agency	Officials — Employees	10.619	.10	20.37	15.74	25.00
8	Expenditure desirable	Officials — Employees	10.127	.09	14.50	9.60	19.40
10	Not worried about risks	Officials — Employees	8.194	.08	23.69	18.78	28.60
21	B/E (composite)	Officials — Inactive	12.918	.11	27.72	23.91	31.54
		Officials — Employees	12.918	.11	28.86	25.20	32.53

about the risks space activities might bear. Similarly, *Nichterwerbspersonen* (i.e., people who are professionally inactive, such as pupils, students, pensioneers, and people incapable of working) and employees tended to be more excited about space activities than officials.

3.2.2 Trust as a key factor

Correlation analyses were performed excluding all respondents who indicated not to have known about ESA. On all attitudinal levels, trust was shown to play a major role (see Table 10).

A moderate correlation was observed with perceived usefulness of space activities. Otherwise, trust was strongly correlated with most other cognitive variables. This included the favourability of Europe's own space agency, whether civil society was able to engage in space activities, as well as the attributed valence of space activities' influence on one's personal life, society, and the economy. Trust was also highly correlated with perceptions of how redundant/necessary ESA space activities are.

Regarding the affective dimension, trust correlated highly with how favourable people saw the expenditure of public money for space activities (the strongest measured effect related to trust), as well as how inspiring they found space activities. Respondents' level of trust in ESA was also strongly correlated with how boring or exciting they perceived ESA space activities in general. The only moderate correlation with trust was observed with risk perception related to space activities (see variable 10, Table 10).

Discussion

4.1 The characteristics of ESA's communication strategy

Our content analysis shows a fundamental misrepresentation of *strategy* in ESA's 2018–2020 communication strategy. Specifically, key strategic concepts such as goals and objectives were confounded and not properly applied; i.e., neither did they adhere to the conventional characteristics of goals and objectives [see e.g., Broom & Sha, 2012; Smith, 2020], nor did they follow a consistent alternative rationale. Additionally, most of the relevant content in the strategic documents was categorised as tactics/activities and was therefore not specifically relevant to communication strategy. This misrepresentation of strategy in concept and

Table 10. Summary of attitudinal correlations with trust in ESA. $p < .001$ applies to all results.

	Variable	r	r^2
2	Agreement: Space activities are useful	.38	.14
3	Agreement: It is good that Europe has its own space agency	.61	.37
4	Agreement: Civil society is able to engage in space activities	.60	.36
5	Negative/positive: Influence of space activities on personal life	.56	.31
6	Negative/positive: Influence of space activities on society	.65	.43
7	Negative/positive: Influence of space activities on the economy	.65	.43
8	Agreement: Expenditure of public money on space activities is desirable	.65	.43
9	Agreement: Space activities are inspiring	.47	.22
10	Agreement: Not worried about the risks of space activities	.54	.29
11	Redundant/necessary: Space activities (composite)	.56	.31
12	Redundant/necessary: Earth observation	.61	.37
13	Redundant/necessary: Human and robotic exploration	.51	.26
14	Redundant/necessary: Space transportation	.56	.31
15	Redundant/necessary: Navigation	.43	.18
16	Redundant/necessary: Space science	.42	.18
17	Redundant/necessary: Technology, engineering and quality	.54	.29
18	Redundant/necessary: Telecommunications and integrated applications	.66	.44
19	Redundant/necessary: Space safety and security	.50	.25
20	Redundant/necessary: Operations	.30	.09
21	Boring/exciting: Space activities (composite)	.58	.34
22	Boring/exciting: Earth observation	.58	.34
23	Boring/exciting: Human and robotic exploration	.38	.14
24	Boring/exciting: Space transportation	.48	.23
25	Boring/exciting: Navigation	.39	.15
26	Boring/exciting: Space science	.58	.34
27	Boring/exciting: Technology, engineering and quality	.52	.27
28	Boring/exciting: Telecommunications and integrated applications	.46	.21
29	Boring/exciting: Space safety and security	.51	.26
30	Boring/exciting: Operations	.43	.18

substance impedes the efficacy of ESA's communication as it implies the lack of a well-founded and coherent framework enabling an ensemble of targeted and purpose-driven communication activities. In the context of European space activities, we empirically confirm Tibbie's [1997] thesis of the commonly false application of strategy in communication practice.

More often than not, well-founded and effective science communication relies on research [e.g., Jensen & Gerber, 2020]. However, we found little evidence of attention to evaluation in ESA's communication strategy. As no stakeholder analysis was conducted in the design phase of the strategy, it comes as no surprise that ESA's Communication Department intends to primarily reach a general audience without considering the plurality of society. By contrast, our survey results prove the existence of different attitudes between different socio-demographic groups, indicating the need for more diversely targeted communication.

The level of scientific rigour applied to ESA's strategic communication is also reflected in how the communication function is embedded within ESA. Instead of contributing to the corporate strategy [see Cornelissen, 2017; Webster, 1990] and being integrated in the organisation's scientific operations [see Borchelt, 2001], the Communication Department sees its own role in reaching "audiences" with "messages" as a service to "customers" (= internal decision-makers). Thus, ESA's communication seems functionally detached from the rest of the scientific organisation. If we regard an organisation's communication function as the mediator of organisational and public interests, this detachment systematically inhibits public participation, and only actively allows for advocacy on behalf of the organisation.

Indeed, we have confirmed ESA's overall PR approach as predominantly press agentry/publicity, according to the basic models described by J. E. Grunig and Hunt [1984]. This strong focus on one-way asymmetrical communication is problematic for multiple reasons. According to Nielsen et al. [2007, p. 7], such an approach can raise "[c]redibility problems [which] are most often caused by an intense need for visibility driven by personal or organizational desires for recognition or financial gain". ESA lays emphasis on conveying competence through its communication, although publics may value this trait less than integrity or dependability, for instance [Borchelt, 2008, p. 153]. From a long-term perspective, a one-way asymmetrical focus is likely to affect the organisational effectiveness negatively, compared to a communication strategy with a two-way symmetrical emphasis [L. A. Grunig et al., 1992]. This is the case because a lack of stakeholder engagement results in disregard for public needs and attitudes. By contrast, two-way symmetrical communication balances different interests through public engagement, or even explores common interests by maximising participation and co-creation [L'Etang, 2006, p. 366; Ströh, 2007, pp. 208–211]. Symmetry is more ethical and effective as it acquires legitimacy, proves credibility, and fosters mutually beneficial relationships of trust [Borchelt & Nielsen, 2014; L. A. Grunig, Grunig & Dozier, 2002, pp. 10–11], granting the organisation a social license to operate [e.g., Dare et al., 2014] and, ultimately, to achieve organisational goals. This is particularly true for publicly funded organisations whose activities have far-reaching socio-economic implications. We must once more stress, however, that we are not advocating for exclusive two-way symmetrical communication by normative classification. Instead, a mixed communication framework which thrives on two-way symmetrical grounds is practicable [J. E. Grunig & Grunig, 1992].

Based on our empirical findings and the state of the art in the literature on (science) PR, strategic communication, and space communication, we conclude that the efficacy of ESA's communication strategy can be enhanced systemically, ethically, and sustainably. If ESA intends to draw on its communication function's full potential in the long-term, we recommend adhering to widely accepted strategic concepts, assigning the communication function a role in strategic management, conducting evaluation to support evidence-based approaches, and adopting a predominantly two-way symmetrical yet diverse science communication agenda.

Furthermore, our recommendations for ethical and strategic science communication at ESA support a wider responsible research and innovation (RRI) value system [see e.g., Owen, Macnaghten & Stilgoe, 2012; Stilgoe, Owen &

Macnaghten, 2013]. Over the last decade, RRI has gained scholarly and policy attention. Most prominently, it was implemented as a cross-cutting theme in the European Commission's Horizon 2020 programme [European Commission & Directorate-General for Research and Innovation, 2014]. If ESA intends to manage their R&I accordingly, the evaluation framework should incorporate adequate RRI indicators (e.g., based on the MoRRI indicators in European Commission, Directorate-General for Research and Innovation and Stilgoe [2019]).

4.2 Diverse attitudes towards ESA and European space activities

A "diverse science communication portfolio" was recommended by Borchelt [2001, p. 208] as an important factor for scientific organisations in general.
We emphasised diversity particularly due to the empirical evidence brought forward in this paper, highlighting not only a variety of attitudes towards ESA and space activities but also differences in attitudes among different publics.

Our findings are consistent with research showing that young women display more negative attitudes towards space activities [Entradas, 2014]. Considering that young people seem to respond best to collaborative decision-making [Sandu, 2014], this is yet another argument in favour of adopting a two-way symmetrical approach in ESA's strategic communication.

The survey results additionally offer new insights into public attitudes towards space activities. We show that *Earth observation* (which includes environmental monitoring) is seen as the most necessary type of space activity, followed by *Space safety and security*. Coherently, findings from the Special Eurobarometer 403 show that Europeans attributed an important future role of space-derived technologies to the environment, and that space technologies are seen as relevant for addressing threats from space, such as asteroids and space debris [TNS Opinion & Social, 2014]. *Earth observation* also elicited the highest level of excitement, closely followed by *Space science*. While our findings support the role of *Space science* as an inspiring 'science catcher' [Madsen & West, 2003], they also shed light on a potentially neglected area of research in this regard, *Earth observation*.

The Eurobarometer survey furthermore found that Europeans were nearly equally divided about whether it is important to further invest in space exploration [TNS Opinion & Social, 2014]. Survey research by Lévy, Lancrey-Javal and Prunier [2019] concluded that on average, Europeans "want €287 of their taxes to go towards the development of European space activities" [p. 26], while about €10 represented the actual amount going into space activities. Lévy, Lancrey-Javal, and Prunier pointed out the methodological constraint of respondents' limited knowledge about how their taxes are distributed. We additionally find using the mean as a measure of central tendency problematic as it is particularly sensitive to outliers. Another bias towards higher values could have been introduced by the order of their survey questions. Conversely, our survey asked respondents for a value irrespective of the total taxes paid, and minimised potential bias arising from the question order.

Although attitudes towards ESA and space activities were generally positive, respondents expressed some uncertainty as to whether civil society was able to engage in space activities and whether potential risks of space activities were

worrying. Individuals also did not see space activities as particularly relevant to their personal lives. Respondents' strong agreement that "it is good that Europe has its own space agency" indicates potential value in making use of 'imagined communities' [Anderson, 1983] by framing European space activities as "our" endeavours.

It is important to acknowledge that our sample was not representative of the target population, nor did our survey encompass all European publics. Nevertheless, our results cohere with other (international) studies' findings and provide evidence for a diversity of public attitudes towards ESA and space activities. The key survey insights discussed above could be useful for general strategic considerations in ESA's communication. However, a more comprehensive set of ex-ante evaluation methods for a fully evidence-based approach across ESA member states is indispensable.

Conclusion

We assessed the efficacy of ESA's strategic communication using a mixed methods approach, including a content analysis of the communication strategy and a public attitudes survey. The juxtaposition of the communication strategy characteristics with best practice in strategic (science) PR and public attitudes towards the Agency revealed a general disconnect from best practice and public attitudes.

Specifically, ESA's communication strategy lays excessive emphasis on press agentry, does not adhere to common strategic structures and concepts, and does not sufficiently incorporate research and evaluation. Moreover, the strategy's focus on addressing 'the general public' as one audience stands in conflict with the evidence for pluralistic publics and diverse attitudes.

We consequently argue that a more inclusive communication strategy aiming to foster trustful relationships with publics would be more efficacious. Such a strategy would be based on comprehensive evaluation and place public participation at its centre. Complemented by a diverse science communication agenda that addresses publics' needs and attitudes, the strategy would shape communication practice in a way that contributes to ESA's organisational goals more effectively and sustainably.

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Conflict of interest

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

Data availability statement

The data that support the findings of this study are openly available in the open-access repository Zenodo at https://doi.org/10.5281/zenodo.5911293.

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