



Press releases shape online attention for neuroscience articles

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Received: 12 February 2025 / Accepted: 29 June 2026 / Published online: 24 July 2026
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Abstract

Communication departments at research centers and universities play a key role in transferring research results and scientific advances to society. This responsibility is inherent to publicly funded research and benefits both: researchers, by increasing visibility and opportunities for further funding, and citizens, who are better informed to make decisions. To fulfil this role, communication specialists use a range of strategies, such as issuing press releases (PRs) and posting on social media. However, despite the widespread use of these tools, evidence-based protocols to optimize promotion are still lacking. In this context, alternative metrics (altmetrics) are particularly useful, as they allow the effects of communication campaigns to be measured and the impact of specific actions to be assessed. In this research, conducted by the communication department of a neuroscience research center, we use simple altmetrics (mainly news mentions and posts on X) and a composite metric (the *Altmetric Attention Score*, AAS) to evaluate the reach and effectiveness of issuing a PR and posting on X about a scientific article. A retrospective analysis revealed that articles supported by active communication efforts achieved stronger altmetrics. This pattern was further supported by a prospective experiment with 25 publications, where the issuance of a PR was followed by a clear rise in online attention. Overall, the study points to the importance of communication activities in shaping the online visibility of scientific outputs, highlighting the value of PRs, while indicating that the *Altmetric* platform, which aggregates altmetrics and provides the AAS, although useful, may underestimate the social impact of a publication by not capturing all mentions.

Keywords Science communication · Altmetric · Press release · Social media · X · Twitter

Introduction

Science plays a central role in contemporary society, contributing not only to the explanation of natural phenomena but also to progress and informed decision-making. In an era of information overload and the proliferation of fake news (Iyengar & Massey, 2019;

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Surjatmodjo et al., 2024), it is essential for citizens to possess solid scientific literacy and to be aware of the latest research findings. This allows them to form well-founded opinions on critical issues such as technological and health advances or environmental practices (Brownell et al., 2013; Martin & MacDonald, 2020; Rother, 2014). Therefore, communicating research results is a fundamental part of scientific activity, not only within the scientific community but also to the public, broadening society's evidence-based knowledge.

Furthermore, in a context where research is predominantly publicly funded, it is essential to ensure that citizens can access the knowledge generated through the resources that they provide. In this sense, many funding agencies require a dissemination plan for the project as part of grant applications (Mea et al., 2016). At the same time, when scientific personnel communicate and interact with the public, citizens show a greater willingness to fund their research (Byrnes et al., 2014).

Communication departments at research centers and universities support researchers in ensuring that the flow of information to the public is effective (Alonso-Flores & Moreno-Castro, 2018). These departments became increasingly common in the late 20th and early twenty-first centuries to manage media relations and disseminate institutional information, and over time, they have become increasingly professionalized ("Trust us, we're not academics", 2006). Nevertheless, evidence-based protocols for science communication remain scarce, and professionals often rely on intuition rather than on systematic approaches.

One of the key challenges of communication officers is understanding how to effectively reach journalists. Although news consumption patterns have shifted and print newspapers and television have lost ground to digital media, news coverage remains a central pathway through which the public accesses information about scientific advances (Schäfer, 2017). Consequently, it is essential for communication departments to understand journalistic dynamics and their preferences.

The classic tool for informing journalists is the press release (PR), a one- or two-page document prepared by communication departments to clearly and concisely highlight an event (NIH, 2018a). They are currently delivered directly to journalists by email (Karolinska Institutet, n.d.) or posted on PR platforms such as *Eurekalert!* or *AlphaGalileo* (Orduña-Malea & Costas, 2023), with the aim of attracting media attention.

Surveys have shown that PRs are a frequent source of story ideas and content for journalists (Bauer et al., 2013; van Trigt et al., 1994). However, their effectiveness depends on selective use, as excessive dissemination may lead to media fatigue and reduced impact (Walters & Walters, 1992). To decide what articles to prioritize, criteria such as public health relevance or scientific novelty are commonly used to assess newsworthiness of biomedical articles (NIH, 2018a), but final decisions cannot avoid some degree of subjectivity and rely on professional experience.

Observational studies suggest that articles accompanied by a PR receive greater media coverage (Fuoco et al., 2023; Stryker, 2002), yet these studies cannot establish whether PRs cause increased attention or are simply issued for articles that are already more newsworthy. The present article addresses the question of causality in the relationship between PRs and news mentions, and compares their effect with that of social media (SM), specifically X (formerly *Twitter*).

Regarding SM, some research has evaluated its potential impact on indicators of scientific interest, such as citations (Branch et al., 2024; Fox et al., 2015, 2016; Tonia et al., 2016), but there remains a lack of literature linking posting on SM to receiving more attention online (e.g., being mentioned in other SM platforms, blogs, digital news outlets, etc.). In this sense, similar to the concerns raised for PRs, Htoo et al. (2023) argue that correlations between news coverage and SM activity may arise because both are driven by shared

newsworthiness characteristics, rather than by direct causal effects. Prospective experiments, such as the one presented in the second part of this article, are needed to clarify the actual impact of each action on the overall attention that an article receives.

To evaluate the effectiveness of a campaign, alternative metrics (altmetrics) are essential, as they track the online social interest that a publication generates over time, allowing comparisons of metrics before and after an intervention. Simple altmetrics capture individual indicators of social attention, such as news mentions or X posts, which can be aggregated by platforms such as *PlumX* or *Altmetric* to provide a broader view of the interest generated. At the same time, composite metrics such as the *Altmetric Attention Score* (AAS), from *Altmetric*, combine multiple indicators into a single value, offering an integrated measure of attention across different online sources (Altmetric, n.d.; Altmetric, 2023; Elsevier, n.d.; Scarlat et al., 2015).

Altmetric is more widely used than *PlumX* as an altmetric data provider platform, due to its broader data collection coverage (Ortega, 2020). However, the literature has reported potential biases in the *Altmetric* detection system as well (Barata, 2019; Fleerackers et al., 2022; Ortega, 2020; Torres-Salinas et al., 2018). In this sense, an additional objective of this work is to critically assess *Altmetric*'s strengths and weaknesses, given its generalized use.

Altmetric data and its composite index, the AAS, are currently available on several scientific publishers' platforms, such as *ACS*, *Cambridge University Press*, *Springer Nature*, *Taylor & Francis* and *Wiley*, while *PlumX* is on *Elsevier*. These publishers also often provide guidelines with outreach plans to achieve greater attention (e.g., Cambridge University Press, n.d.; Clark, 2025; MDPI, n.d.; Springer Nature, n.d.; Taylor & Francis Author Services, n.d.). Nonetheless, the evidence underlying these recommendations is not clearly specified.

To address the lack of supporting data, in the first part of this article we present a study in which we examined the social impact of 201 articles from our research center, the *Institut de Neurociències de la Universitat Autònoma de Barcelona* (INc-UAB), categorized according to the actions carried out by our communication department. The objective is to determine whether active communication campaigns are associated with higher online attention, measured using various altmetric indicators provided by *Altmetric*. Then, to establish causal relationships, a prospective experiment involving 25 articles generated in our institution is conducted, analyzing altmetric changes before and after issuing a PR or posting a publication on SM. Our conclusions not only offer guidance for science communication professionals and researchers but also provide critical insights into the data provided by *Altmetric* (including the AAS) and its use.

Methods

In this section, we detail the sample selection process for the retrospective analysis, including the inclusion and exclusion criteria, as well as the approach taken for the prospective study. Lastly, we describe the statistical analysis conducted in each case.

Selection of publications

A Scopus search by author ID, of 61 INc-UAB principal investigators, was performed in October 2021, obtaining a list of 718 publications from 2016 to 2020. To increase the

sample, a second search was done in January 2023, obtaining 182 additional publications from 2021. We only selected original articles in English where an INC-UAB member was the principal author (only first or last author contributions were considered, according to the criteria of leadership in the neuroscience field), resulting in 201 publications.

As all principal authors were in-house members, our press department had been in charge of the communication campaign, and the outreach strategy followed in each case was controlled and perfectly known. Hence, we divided the publications into two groups: those that were subject of a PR (PR group, $n=28$) and those that were not (NPR group, $n=173$).

We obtained the DOI, title, authors, year, and source title from *Scopus* (January 2023). The Impact Factor (IF) was obtained from the *Journal of Citations Reports* from *Web of Science* (WoS, Clarivate), considering the year when each article was published. Using the *Altmetric* API (Dec. 2021 and Jan. 23), we collected the number of mentions in the news, *X* posts, *Facebook* posts, *Mendeley* readers, AAS, and AAS percentile within the same journal (Fig. 1).

The *PlumX* API was also used to obtain altmetric data. However, when we manually reviewed some of the data, we detected substantial differences compared with what we directly observed on *X* or *Facebook*, so we ultimately discarded this source.

Prospective experiment

The second investigation of this study consisted in the analysis of the prospective outcome of in-house neuroscience publications when undergoing controlled dissemination campaigns. During 2022 and 2023, 25 original articles from members of our center as principal authors were selected and divided into two groups: those for which we would deliver a PR (PR' group, $n=12$) and those for which we would not (NPR' group, $n=13$). The division

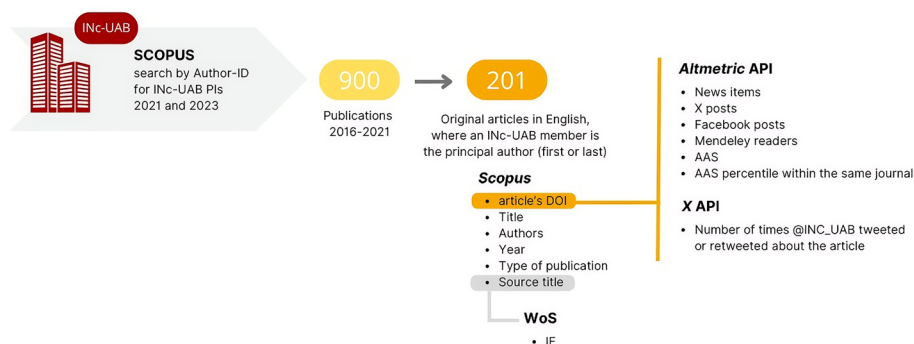


Fig. 1 General procedure for data extraction of publications by INC-UAB Members (2016–2021). We performed two searches on *Scopus* using the author IDs of 61 principal investigators affiliated to INC-UAB: one in October 2021 and another in January 2023. This yielded a total of 900 publications from 2016 to 2021. We retained only original articles published in English, with an INC-UAB member as the principal author, resulting in a final dataset of 201 articles. Key details, including the DOI, title, authors, year, and source title were extracted from *Scopus*. The IF was sourced from WoS. Additionally, using the *Altmetric* API, we collected metrics such as mentions in the news, posts on *X* and *Facebook*, *Mendeley* readers, AAS, and AAS percentile within the journal. Finally, the *X* API provided with the tweets and retweets mentioning each article, as well as the users who posted them

was made considering a fork decision tree that importantly took into account 1) whether the article would be of general interest, 2) the preference of the author/s, and 3) the time elapsed between the publication of the article and the start of the communication campaign (Fig. 2).

In our analysis, we categorized articles as not newsworthy if they focused, for example, on laboratory protocols, the validation of animal models, or highly specific biochemical pathways without clinical implications. Although these criteria may introduce bias, the articles selected for our study were compared to themselves before and after the communication efforts, allowing each publication to serve as its own control. Therefore, any observed differences in attention metrics reflect the impact of the dissemination campaign. That said, further research to better define what truly captures public interest would be highly valuable.

Within the PR' and the NPR' groups, we applied another subdivision: those articles for which we would prepare dissemination materials for publication in SM (sm articles), particularly on *X* and *Instagram* (IG) (PR'sm and NPR'sm groups), and those for which we would not (n articles) (PR'n and NPR'n groups). For this subdivision, we also had to consider the preferences of the leading authors. Although the articles in the PR'n and NPR'n groups were intentionally not tweeted, they could be retweeted upon the authors request. These articles remained in the n groups, as such actions were deemed residual (Table 1).

We also made a third subdivision based on the timing of the communication efforts, in relation to the online publication date of each article. According to Fang and Costas (2020), by day 22 after the publication of an article, half of the mentions in the news, and around 60% of the *X* posts have already happened. Considering this, we set up two groups taking into account whether these 22 days have passed or not (+22 or -22) before the campaign started. On the one hand, PR'₊₂₂ and NPR'₊₂₂ (including PR'₊₂₂sm, NPR'₊₂₂sm, PR'₊₂₂n, and NPR'₊₂₂n) refer to those articles for which the communication actions took place at least 22 days after their publication (from day 22 onwards). On the other hand, PR'₋₂₂sm, NPR'₋₂₂sm, PR'₋₂₂n, and NPR'₋₂₂n refer to those for which the communication campaign started before day 22 (from day 0 to 22) (Fig. 3). Throughout the manuscript and tables, the subscript on each article reference indicates the exact number of days since its publication.

To generate a PR, our communication department worked together with the press office of our university (Universitat Autònoma de Barcelona, UAB), and counted on

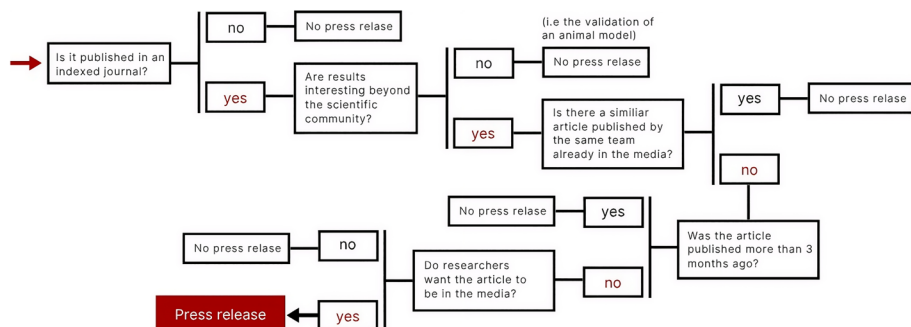


Fig. 2 Decision tree on the choice of sending a PR about a scientific article. *Note:* the three-month limitation is due to *Eurekalert!* policy only allowing posting news about publications within the last 90 days

Table 1 Description of the communication actions carried out for each article on X. The subscript in the reference indicates the number of days between the article's publication and the start of the advertising campaign. *Note:* The article PR'68n corresponds to article n(6') in graphs 10b, 12b, and 14

Reference and group	IF	Publication date	Comm. Campaign start	Days of delay	X actions by @INC-UAB
PR'0sm	25	16.06.2022	16.06.2022	0	Thread on X on the same day as article publication and PR issuance; 7 RTs the following day; 1 RT one week later; 1 tweet 53 days later (summer reminder).
PR'1sm	3.7	08.05.2023	09.05.2023	1	1 thread on X and 1 RT on the same day as the PR (one day after article publication).
PR'8n	6.2	30.06.2022	8.07.2022	8	-
NPR'0n	16.6	28.07.2022	10.08.2022	0	1 RT 100 days after the publication.
NPR'0n	7.9	11.06.2022	11.06.2022	0	1 RT 2 days after the publication.
PR'38sm	6.1	08/02/2022	18/03/2022	38	1 tweet and 1 RT on the day of the PR (38 days after article publication); 2 RTs the following day (day 39).
PR'83sm	9.3	02.02.2022	26.04.2022	83	2 tweets (part of the same X thread) and 2 RTs on the day of the PR (83 days after publication); 1 RT the following day (day 84); 1 tweet 114 days after (summer reminder).
PR'88sm	7	16/09/2022	13/12/2022	88	1 tweet on the day of the PR (88 days after publication) and 1 tweet one week later (day 95).
PR'41sm	5.9	24/03/2023	04/05/2023	41	1 thread on X the day after the PR (day 42).
PR'23sm	6	30/05/2023	22/06/2023	23	2 RTs one day after publication; 1 RT 14 days after publication; 1 thread on X on the day of the PR (23 days after publication).
PR'75n	6	08/01/2022	24/03/2022	75	-
PR'56n	2.6	24.03.2022	19.05.2022	56	-
PR'68n	6	14/10/2022	21/12/2022	68	-
PR'64n	6.9	17/05/2023	20/07/2023	64	-
NPR'28sm	5.3	21.09.2022	19.10.2022	28	1 RT one day after the publication. 1 X thread the day 28. 1 RT of the X thread on the day 29 and the day 33.
NPR'32sm	3.3	22.04.2022	24.05.2022	32	1 X post 32 days after the publication. 1 summer reminder 124 days after.
NPR'31sm	4.6	09.05.2022	09.06.2022	31	1 RT 3 days after the publication. 1 X thread 31 days after the publication. 1 tweet 105 days after (summer reminder).
NPR'129sm	2.1	01.02.2022	10.06.2022	129	1 X thread 129 days after the publication. 2 tweets 199 days after (summer reminder).
NPR'25sm	5.6	28.11.22	23.12.2022	25	2 tweets (part of the same thread) 25 days after the publication. 1 tweet 28 days after the publication.
NPR'75sm	2.9	22.01.2022	07.04.2022	75	1 X thread 75 days after the publication. 1 tweet 216 days after (summer reminder).
NPR'27sm	4.1	14.10.22	10.11.2022	27	2 tweets (contained in 1 X thread) 27 days after the publication. Another X thread on the day 34.
NPR'52n	1.3	05.03.2022	26.04.2022	52	-
NPR'90n	5.6	01.04.2022	03.06.2022	90	-
NPR'59n	4.7	11.04.2022	09.06.2022	59	1 RT 11 days after the publication.
NPR'45n	7.4	11.11.22	26.12.2022	45	-

the collaboration of the publication authors (Fig. 4). Our PRs consisted of a summary text of the article, following the *National Institute of Health* (NIH) recommendations (Fig. 5), accompanied by one or two images. PRs were delivered to journalists working

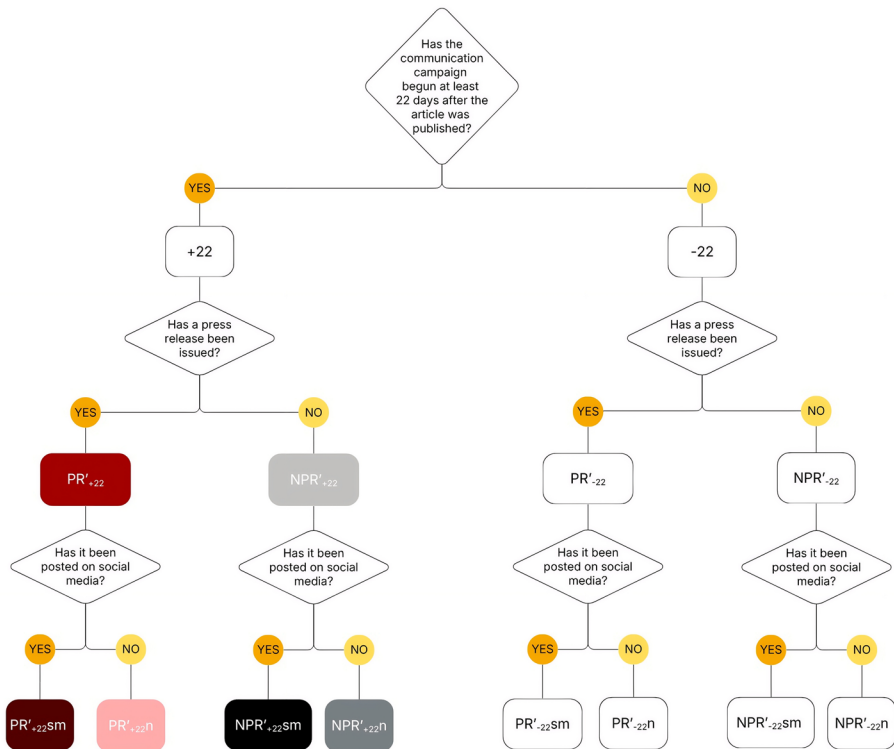


Fig. 3 Classification tree of the sample from our prospective study

in Spanish and Catalan media outlets, and an English version was posted on *EurekaAlert!* and *AlphaGalileo*, which are platforms to share research news internationally.

Regarding SM, we used *X* and not *Facebook*, as nowadays the usage of *Facebook* follows a steady decline (Cannarella & Spechler, 2014). Sm articles were also posted on IG, which at this moment is not tracked by *Altmetric* but allowed us to engage and communicate with our student community. Materials for *X* and IG were created with inspiration from the *Three Facts and a Story* method described by Tapper et al. (2021), following the next design and posting strategy:

For IG—One carousel post per article with text and images, following the structure: 1–3 images for the introduction, 1–3 to explain the article, and 1–2 to explain the importance of the contribution (see a diagram and an example in Fig. 6). On the post text, we included the hashtag #articedeldia (“article of the day”, in Catalan) and a short sentence indicating that the link to the article could be found on the INC-UAB IG profile. The post was shared once as an IG story, tagging the researchers involved.

For *X*—A thread with the same information posted on IG but adapted to *X*, using the same hashtag #articedeldia (Fig. 7). We tagged the journal, authors, labs, and other research centers involved in the study when they had *X* accounts. Exceptionally, in two cases, we only posted one tweet with all the information instead of a thread. The thread/tweet was shared once and, in some cases, repeated (or a summary of it) three or four

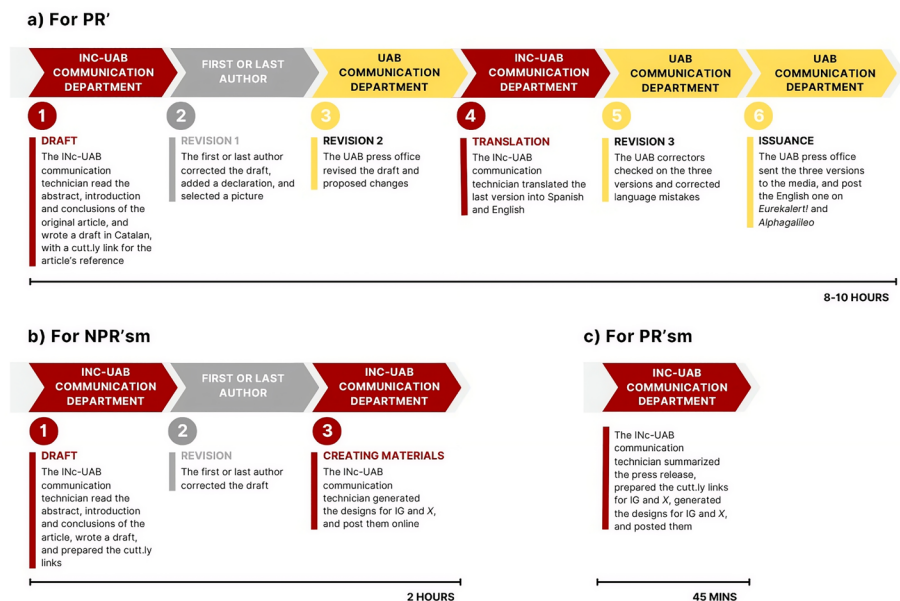


Fig. 4 Internal workflows at Inc-UAB. **a** For preparing a PR **b** and **c** For generating SM posts about an article

days later. Also, for 6 of them (2 in the PR'sm group, and 4 in the NPR'sm group) a reminder was posted a few months later, coinciding with the summer holidays (Table 1).

Of all the articles, there was one (PR'83sm) that was also highlighted on the *LinkedIn* account at the authors' request. However, we stopped using this platform because we did not have a strong community there, *Altmetric* was not providing *LinkedIn* information at the time when this study was performed, and we did not want to introduce additional variables. As it was said above, *Altmetric* was not collecting IG either, but we used it principally as an internal communication channel with our students.

Data was collected six times along the timeline: just before the communication campaign started, and one day, three days, one week, one month, and three months after the communication campaign. We used the *Altmetric Explorer*, the *X* searcher, and *Google* to gather the data. Tweets and retweets (RTs) were counted as one *X* post, following *Altmetric* criteria. Data regarding the days before the start of the communication campaign was calculated afterwards, using the *Altmetric Explorer* and the indicative score table provided by *Altmetric* (Altmetric, 2023).

Finally, regarding the analysis of the news items, which included checking their language and whether they properly referenced the article, it was conducted in August 2025. In some cases, the full text was no longer accessible; however, since the title had been recorded beforehand, we were still able to determine the language.

Statistical analysis

For the first study, we used Pearson coefficients for correlations and the t-student test for comparing two groups. Partial correlations and ANCOVA tests were also

Fig. 5 Example of a PR produced by the INc-UAB communication department, following the standard format used by the UAB, to announce the publication ‘*Cerebellar dopamine D2 receptors regulate social behaviors*’ (PR’0sm). Once drafted, it was reviewed, at a minimum, by the lead author and the UAB press office, to ensure that the content, structure and language were optimal

Fig. 5 Example of a PR produced by the INC-UAB communication department, following the standard format used by the UAB, to announce the publication ‘*Cerebellar dopamine D2 receptors regulate social behaviors*’ (PR’0sm). Once drafted, it was reviewed, at a minimum, by the lead author and the UAB press office, to ensure that the content, structure and language were optimal



Fig. 6 IG posts to share the results and contributions of a research article. **a** Scheme for an IG post. **b** Example of IG carousel for the publication “Cerebellar dopamine D2 receptors regulate social behaviors” (PR_{0sm}): https://www.instagram.com/p/Ce34whGipIj/?img_index=1

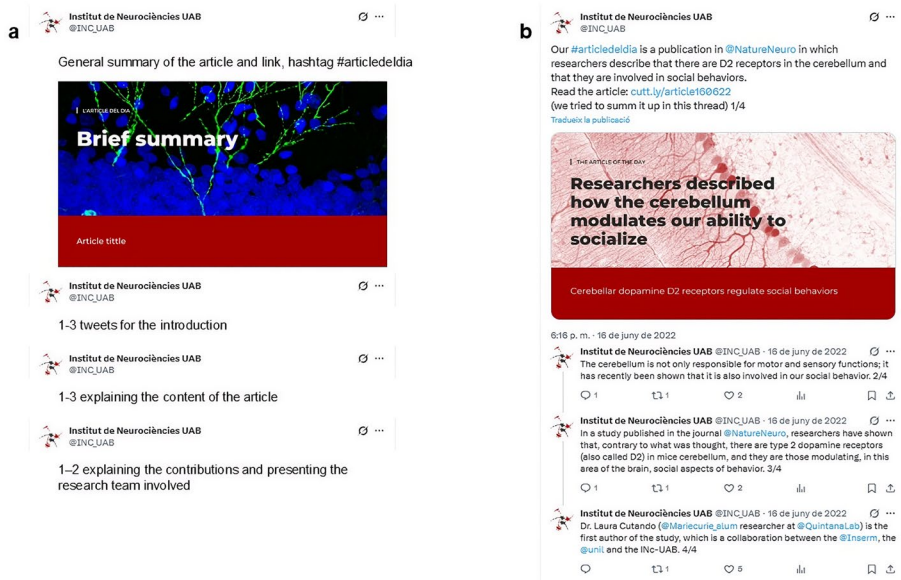


Fig. 7 X posts to share the results and contributions of a research article. **a** Scheme for a X post; **b** Example of a X post for the publication “Cerebellar dopamine D2 receptors regulate social behaviors” (PR’₀sm): https://x.com/INC_UAB/status/1537469047788425219

performed to control the effect of particular variables. When homogeneity of variance was not achieved, logarithmic transformations were performed or we used non-parametric tests (Spearman). For the matched analysis, a KDTree algorithm (implemented in Python) was used to find the nearest IF in each case, ensuring that each match was unique and avoiding duplicates. Then a paired t-test was performed. All variables were considered to be equivalent among the years, as their main accumulation usually is very fast within the first few days after the publication (Fang & Costas, 2020).

For study 2, comparisons between articles with and without PR, and with and without SM campaigns, were conducted using ANOVA and ANCOVA.

Analyses were performed using *Statistical Package for the Social Sciences* (IBM SPSS Statistics 29.0.2.0), and graphics were created with *GraphPad Prism 8.0.1*. Statistical significance was assessed as * $p < 0.05$ and ** $p < 0.01$.

Results

Retrospective study

We analyzed 201 publications with known campaign details. The aim was to examine whether active communication efforts are associated with enhanced altmetric performance, as reflected in the number of X posts, news mentions, and the resulting AAS.

Retrospective analysis indicates that articles with a press release have stronger altmetric performance

Since previous studies suggest that PRs greatly improve media attention (Cho & Yoon, 2019; de Semir et al., 1998; Fuoco et al., 2023; Stryker, 2002), we compared those in-house articles for which we delivered a PR (PR group) to those for which we did not (NPR group).

After removing false positives from *Altmetric*, where records from the *Alzforum* website (which only lists article references) and PR platforms (in which we uploaded the PR) had been counted as news, the PR group ($n=28$) received almost seven news items on average, according to *Altmetric*, whereas the NPR group ($n=173$) received fewer than 0.1 (Fig. 8a).

PR articles not only received more mentions in the news but experienced a ripple effect reflected in 3.7 times more *X* mentions, according to *Altmetric* data (Fig. 8b). This difference could be partly explained by the fact that issuing a PR is often associated with a more active SM campaign by the institutions, although this was not the case for our articles in many instances. The *X* API was used to have a record of the number of times the institutional account (@INC_UAB) tweeted or retweeted an article. According to this data, the in-house account posted original tweets for 27 of the 201 articles (11 PR and 16 NPR) and

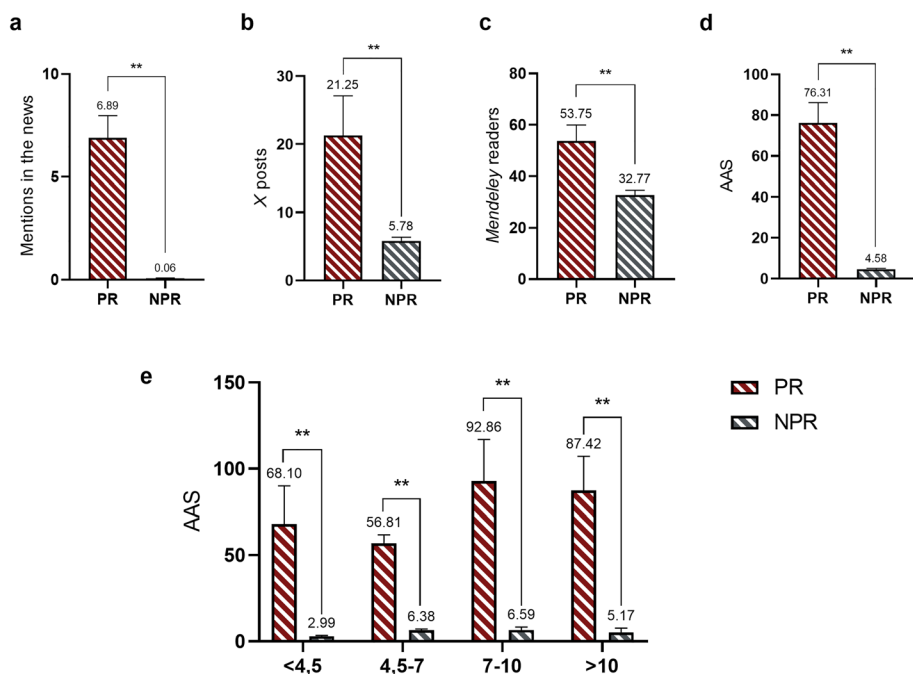


Fig. 8 PR articles have higher altmetrics, regardless of the IF. Comparison between PR and NPR groups regarding; **a** The number of mentions in the news according to *Altmetric*, after removing false positives [$t(199)=-29.087$, $p<0.01$]; **b** The number of *X* posts according to *Altmetric* [$t(199)=-6.263$, $p<0.01$]; **c** The *Mendeley* readers according to *Altmetric* [$t(199)=-4.457$, $p<0.01$]; **d** The AAS [$t(199)=-15.541$, $p<0.01$]; **e** The AAS, per IF: <4.5 [$t(97)=-9.274$, $p<0.01$], 4.5–7 [$t(69)=-6.359$, $p<0.01$], 7–10 [$t(16)=-5.948$, $p<0.01$], >10 [$t(11)=-5.506$, $p<0.01$]. *Note*: While the graphical representation utilizes untransformed data for clarity, the underlying statistical analyses (t-tests) and their interpretations are based on the logarithmically transformed datasets

19 of these were not only tweeted but also retweeted (10 PR and 9 NPR). Other 25 articles had from 1 to 8 RTs from @INC_UAB, without any original tweets from this account (2 PR and 23 NPR). Finally, 149 articles did not receive any mentions from @INC_UAB (15 PR and 134 NPR).

PR articles also had 1.6 times more readers on *Mendeley* (Fig. 8c) and a mean AAS of 76.3, whereas articles in the NPR group ($n=173$) had an average AAS of 4.58 (Fig. 8d). This represents a 16.6-fold difference, indicating that delivering a PR may be a critical action to increase the general online social attention of an article. Notably, this effect was observed across all IF ranges (Fig. 8e).

Given that the IF could be a confounding variable, we controlled for the effect of IF when assessing the influence of the PR. An ANCOVA test showed that the PR effect remained highly significant for the number of *X* posts [$F(1,198)=20.720$, $p<0.01$], *Mendeley* readers [$F(1,198)=14.531$, $p<0.01$], and AAS [$F(1,198)=178.740$, $p<0.01$], while it was not possible to calculate for the number of mentions in the news due to the NPR group having not enough variance. Since this was the case, a matched analysis comparing the mentions in the news between PR and NPR articles with similar IFs was performed, showing that significant differences between the two groups persisted [$t(27)=-13.693$, $p<0.01$].

Publications on *X* did not affect media coverage

To assess the impact of SM, we focused on articles without a PR (NPR). Only 9 of the 173 articles received any news coverage, once false positives from *Altmetric* were removed. After controlling for IF, partial correlation analyses revealed no significant relationship between the number of tweets and either news mentions or citations. In contrast, a moderate association was observed between *X* posts and the number of *Mendeley* readers [$r(170)=0.277$, $p<0.01$].

Prospective experiment

Given that our retrospective analysis suggests that a PR could be a key factor in boosting the altmetrics of a publication, in this part of the study we test its real impact by comparing the metrics before and after the dissemination campaign.

Mentions in the news only happened for articles with a press release

After waiting at least 22 days after the publication of the article, the communication campaign (consisting of SM posting or issuing a PR) started. Articles for which a PR was distributed (PR'_{+22} , $n=9$) began receiving mentions in the news just hours after the issuance, whereas articles without a PR (NPR'_{+22} , $n=11$) received none. According to *Altmetric*, and after excluding false positives (records from *Alzforum*, *Eurekalert!* and *AlphaGalileo*, which are not news items), within the PR'_{+22} group, those that were highlighted on SM (PR'_{+22sm} , $n=5$) showed the highest number of mentions, reaching an average of 9.2 per article, while those that were not posted on SM (PR'_{+22n} , $n=4$) averaged 4 mentions, one week after publication (Table 2). However, these numbers were actually underestimated, as *Altmetric* does not capture a considerable number of news sources. Using *Google* search, we found that 106 news mentions were overlooked, representing 63% of the total (Fig. 9, Tables 2 and 3).

Table 2 Mentions in the news before and one week after sending a PR (for PR_{+22sm} and PR_{+22n} articles), posting the article in the institutional SM accounts (for PR_{+22sm} and NPR_{+22sm} articles), or starting the monitoring process for the control group (NPR_{+22n}). Data includes mentions detected by *Altmetric* and those undetected, gathered via manual searches. *Note:* The mentions marked with an asterisk (*) are not pieces of news, although *Altmetric* would count them as such, but rather a citation in *Alzforum* or the PR itself posted on the platforms *Eurekalert!* or *AlphaGalileo* by the communication office of the University. These false positives were excluded from the statistical analyses and figures

	IF	Before (ALT)	1w (ALT)	Δ 1w (ALT)	Before (search)	1w (search)	Δ 1w (search)	Total Δ	Total $\Delta\%$
PR _{36sm}	6.1	1*	12 (2*)	11 (1*)	0	16	16	26 (1*)	2600%
PR _{83sm}	9.3	0	11 (2*)	11 (2*)	0	17	17	29 (2*)	-
PR _{88sm}	7	0	18 (2*)	18 (2*)	0	8	8	26 (2*)	-
PR _{41sm}	5.9	0	8 (2*)	8 (2*)	0	14	14	21 (2*)	-
PR _{23sm}	6	0	6 (1*)	6 (1*)	0	7	7	13 (1*)	-
PR _{75n}	6	0	6	6	0	28	28	34 (1*)	-
PR _{56n}	2.6	1	8 (1*)	7 (1*)	0	9	9	16 (1*)	1600%
PR _{68n}	6	1*	5 (2*)	4 (1*)	0	5	5	9 (1*)	900%
PR _{64n}	6.9	0	2 (1*)	2 (1*)	0	2	2	4 (1*)	-
NPR _{28sm}	5.3	0	0	0	0	0	0	0	-
NPR _{32sm}	3.3	0	0	0	0	0	0	0	-
NPR _{31sm}	4.6	1*	1*	0	0	0	0	0	0%
NPR _{129sm}	2.1	0	0	0	0	0	0	0	-
NPR _{25sm}	5.6	0	0	0	0	0	0	0	-
NPR _{75sm}	2.9	0	0	0	0	0	0	0	-
NPR _{27sm}	4.1	0	0	0	0	0	0	0	-
NPR _{52n}	1.3	0	0	0	0	0	0	0	-
NPR _{90n}	5.6	1*	1*	0	0	0	0	0	0%
NPR _{59n}	4.7	0	0	0	0	0	0	0	-
NPR _{45n}	7.4	0	0	0	0	0	0	0	-

Among the undetected pieces, 10% contained an article reference or a link, 70% did not, and 21% could not be verified as the piece was no longer available. On the other hand, among the detected pieces, 59% contained an article reference or a link, 11% did not, and 30% could not be checked (Table 4). Interestingly, when counting detected and undetected news items, 55% of the pieces that could be verified lacked a reference, which hinders the traceability of the information.

After adding the undetected mentions to those already recorded by *Altmetric*, we observed that within one week, PR_{+22sm} articles received an average of 21.6 mentions per article; PR_{+22n}, of 15, and NPR₊ groups did not receive any (Figs. 9 and 10, Table 2).

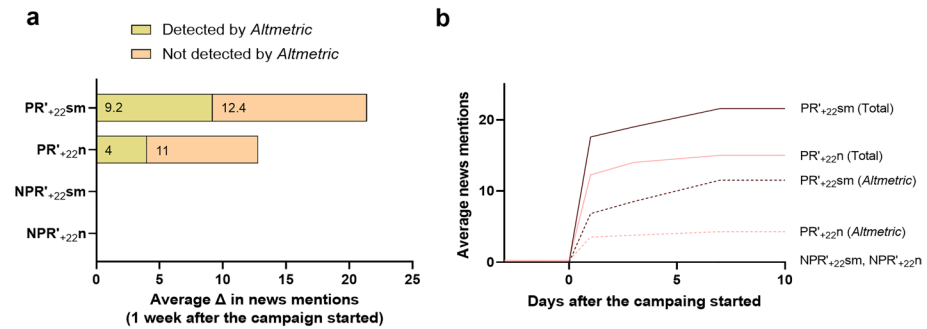


Fig. 9 A PR boosts news mentions, considering the impact detected and non-detected by *Altmetric*. **a** Average increase in the number of mentions in the news per group, one week after the communication campaign/monitoring started, detected and undetected by *Altmetric*. **b** Average increase in the number of mentions in the news per group, starting at day -3 before the communication campaign/monitoring started, and until 10 days after. The dashed line represents the mentions detected by *Altmetric*, while the solid line represents the total, including both detected and undetected mentions. *Note:* While ‘a’ utilizes untransformed data for clarity, the underlying statistical analyses and their interpretations are based on the logarithmically transformed datasets, ensuring the rigor of our findings

Moreover, the increase was observed in articles published in both low- and high-IF journals (Fig. 10b).

Regarding the factors that influenced the differences among groups, after adjusting for IF, the analysis of covariance showed that the interaction between TIME (the moment at which mentions were counted) and PR [$F(1,15)=149.204$, $p<0.01$] was statistically significant, while all the other interactions were not [TIME $\times$ SM, PR $\times$ SM, TIME $\times$ PR $\times$ SM]. This suggests that the PR is the primary factor that drives the increase in news mentions. In line with this, the decomposition of interactions showed that, prior to the intervention, group differences in the number of news mentions were not statistically significant, whereas PR had a significant effect afterward [$F(1,15)=159.832$, $p<0.01$]. SM had no such effect, indicating that the PR is the key factor affecting news mentions.

Press releases increase the number of tweets about an article

When examining the impact of a PR on SM, notable effects were observed. One week after the PR, PR' +22sm articles presented a significant increase in *X* posts (tweets and RTs), with a fourfold rise, averaging 19 posts detected by *Altmetric*. In contrast, articles with similar SM campaigns but without a PR (NPR' +22sm) only experienced a modest increase, with a 1.9-fold rise, averaging 8.9 posts. On the other hand, when SM campaigns were not applied, articles disseminated with a PR (PR' +22n) still showed an increase in the number of *X* posts, although smaller (1.8-fold, reaching an average increase in 2.5 posts), while the increase was null (0 posts) for those with neither a PR nor a SM campaign (NPR' +22n) (Table 5).

As with news mentions, it is important to highlight that *Altmetric* did not account for a large number of tweets. Specifically, those that did not explicitly cite the publication were excluded from the score, meaning that posts referring to news coverage of the article, rather than the article itself, are overlooked. When using the *X* search function, we discovered that undetected *X* posts made up 82% of the total *X* posts for PR' +22 articles but were absent for articles without a PR (Figs. 11 and 12, Table 5).

Table 3 News outlets mentioning each PR article from the prospective study, classified by if they were detected through *Altmetric* or identified independently through manual searches. *Notes:* One media outlet may have more than one news item about one single article (not a translation, but a different piece). The outlets marked with an asterisk are not media platforms, although *Altmetric* would count them as such. These false positives were excluded from the statistical analyses and figures

	Media outlets detected by <i>Altmetric</i>	Media outlets undetected by <i>Altmetric</i>
PR [*] _{38sm}	Alzforum*, AZO Life Sciences, Bioengineer.org, Day to News, Ebiotrade, EurekAlert!*, MedicalXpress, Mirage News, News-Medical, ScienceDaily, Scienmag, Technology Networks	Biotech, Cope, ConSalud, Corporació Catalana de Mitjans Audiovisuals, Espanol News, La República, La Vanguardia, La Vanguardia, Lleida Diari, Madrimasd, N3WS Tercera Edad, Noticias De, PuntValles, Salud a diario, Siglo XXI
PR [*] _{83sm}	AlphaGalileo*, BioSpace, Drug Discovery from Technology Networks, EurekAlert!*, Jano, Labroots, MedicalXpress, Mirage News, New Atlas, News Medical Life Sciences, Nouvelles du Monde, ScienceDaily	Cope, Corporació Catalana de Mitjans Audiovisuals, Crónicas de Cantabria, Diario de Castilla-La Mancha, Diario de León, Diari Lleida, Gente en Catalunya, IM Médico, La República, La Vanguardia, Noticias De, Redacción Médica, Salud a Diario, Siglo XXI, Zamora 24 Horas
PR [*] _{88sm}	AlphaGalileo*, ANI, Big News Network, Ciencianewsnet.in, Devdiscourse, ETHhealthworld.com, EurekAlert!*, Journalbreak.com, LatestLY, Medical Xpress, Mirage News, New Kerala, News Medical Life Sciences, Newswise, Scienmag, ThePrint, Todayuknews	Aula de la Farmacia, Biotech Spain, Crónica de Cantabria, Dicyt, IM Médico, NoticiasDe, Ok Diario, Siglo XXI
PR [*] _{41sm}	AlphaGalileo*, El Debate, EurekAlert!*, Medical Xpress, medindia, Mirage News, News Medical	Biotech Spain, Corporació Catalana de Mitjans Audiovisuals, Cope, Diari de Sabadell, Diari Més Digital, El Imparcial, IM Farmacias, IM Médico, La Vanguardia, LaRepública, Nius Diario, Segre, TecnoXplora (laSexta)
PR [*] _{23sm}	EurekAlert!*, Health-Care-in-Europe, Medical News Today, Medical Xpress, Mirage News, Technology Networks	Biotech Spain, Corporació Catalana de Mitjans Audiovisuals, Info Cerdanyola, La Vanguardia, LaRepública, Neuroscience News, Study Finds
PR [*] _{75n}	AlphaGalileo*, Bionity, Catalunya Vanguardista, Medical Xpress, Mirage News, Technology Networks	Andalucía Información, betevé, Cope, Dicyt, Diari Més Digital, Empordà, Gente en Catalunya, IM Médico, imaginaradio, LaRepública, La Vanguardia, Lleida Diari, Lleida.com, Radio Televisión Canaria, Redacción Médica, Regió7, Ronda Semanal, Saber Vivir, Telecinco, VivaCádiz, VivaEstepona, VivaGalicia, VivaHuelva, VivaJerez, VivaMálaga, VivaSevilla, Vivaelpuerto
PR [*] _{56n}	AlphaGalileo*, Alert Breaking News – United States, Mirage News, News Medical Life Sciences, Phys, ScienceDaily, Shenzhen Daily, Thinking Port	20minutos, ABC, Cope, Diari de Tarragona, Head Topics, La Vanguardia, La Voz de Cádiz, LaRepública
PR [*] _{68n}	AlphaGalileo*, Alzforum*, Journalbreak, Mirage News, Todayuknews	Biotech, Corporació Catalana de Mitjans Audiovisuals, Diari de Sabadell, La Noción, LaRepública
PR [*] _{64n}	AlphaGalileo*, Mirage News	El Ideal Gallego, NoticiasDe

When taking into account the posts detected and undetected by *Altmetric*, and adjusting for IF, we saw that the interaction TIME $\times$ PR was statistically significant [$F(1,15)=19.287$, $p<0.01$], while all the other interactions were non-significant. This suggests that the presence of a PR is the main factor underlying the increase in X posts.

Table 4 Distribution of the pieces of news detected and undetected by *Altmetric*, according to language and the presence of a reference or link to the publication within the text

	English	Spanish	Catalan	Other
Detected—referencing	40	4	0	1
Detected—not referencing	6	2	0	0
Detected—unknown	18	4	0	1
Undetected—referencing	2	8	0	0
Undetected—not referencing	0	47	26	0
Undetected—unknown	0	17	5	0

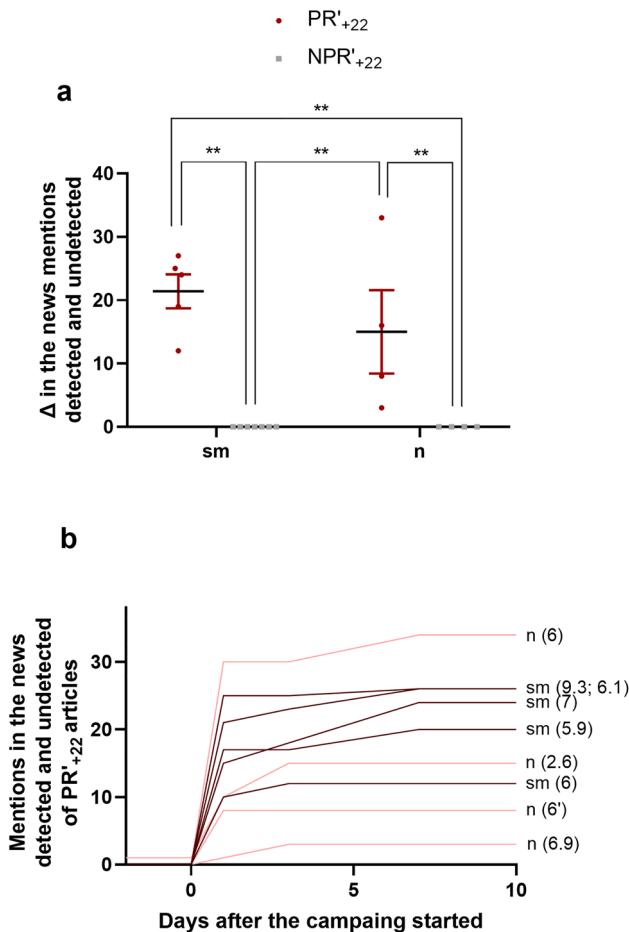


Fig. 10 A PR increases news mentions, regardless of the IF. **a** Differences among groups regarding their increase in the number of mentions in the news detected and undetected by *Altmetric*, one week after the communication campaign/monitoring started. **b** Increase in the number of mentions in the news in PR'_{+22} articles (in brackets, the article IF) *Note:* While ‘a’ graphical representation utilizes untransformed data for clarity, the underlying statistical analyses and their interpretations are based on the logarithmically transformed datasets, ensuring the rigor of our findings

Table 5 X posts were analyzed before and one week after the PR and SM campaigns, or during the corresponding monitoring period. Data includes those posts detected by *Altmetric* and those undetected, gathered via manual searches. *Note:* *Altmetric* did not detect two of our tweets, although they were correctly referenced (cases are marked with an asterisk and are counted in the ‘search’ column)

	IF	Before (ALT)	1w (ALT)	Δ 1w (ALT)	Before (search)	1 w (search)	Δ 1 w (search)	Total Δ	Total $\Delta\%$
PR' _{38sm}	6.1	5	15	10	0	40	40	50	1000%
PR' _{83sm}	9.3	0	19	19	0	112	112	131	-
PR' _{88sm}	7	2	5	3	0	10	10	13	650%
PR' _{41sm}	5.9	5	16	11	0	30	30	41	820%
PR' _{23sm}	6	12	39	27	0	76	76	103	858%
PR' _{75n}	6	1	2	1	0	39	39	40	4000%
PR' _{56n}	2.6	3	4	1	2	15	13	14	280%
PR' _{68n}	6	3	10	7	0	21	21	28	933%
PR' _{64n}	6.9	6	7	1	0	10	10	11	183%
NPR' _{28sm}	5.3	11	19	8	0	0	0	8	73%
NPR' _{32sm}	3.3	1	1	0*	0	1	1	0	0%
NPR' _{31sm}	4.6	13	22	9	0	0	0	9	69%
NPR' _{129sm}	2.1	1	1	0*	0	1	1	0	0%
NPR' _{25sm}	5.6	4	7	3	0	0	0	3	75%
NPR' _{75sm}	2.9	2	3	1	0	0	0	1	50%
NPR' _{27sm}	4.1	1	9	8	0	0	0	8	800%
NPR' _{52n}	1.3	2	2	0	0	0	0	0	0%
NPR' _{90n}	5.6	7	7	0	0	0	0	0	0%
NPR' _{59n}	4.7	8	8	0	0	0	0	0	0%
NPR' _{45n}	7.4	3	3	0	0	0	0	0	0%

Moreover, the decomposition of these interactions indicated that, before the intervention, the differences among groups were statistically non-significant, whereas after the interventions, the PR factor was statistically significant [$F(1,15)=16.848$, $p<0.01$]. The number of tweets significantly increased after the PR but not after the SM intervention, indicating that the PR is the key variable responsible for the increase in posts.

Finally, the impact of the number of times each article was tweeted or retweeted by the institutional account cannot be analyzed due to sample limitations, although differences did not seem to be relevant.

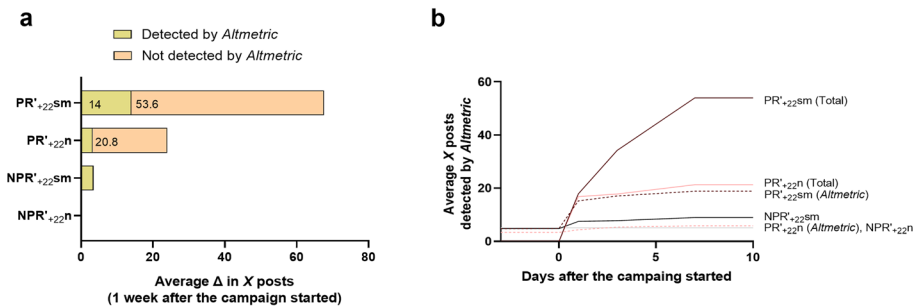


Fig. 11 A PR boosts X mentions, considering the impact detected and non-detected by *Altmetric*. **a** Average increase in the number of X posts per group detected and undetected by *Altmetric*, 1 week after the communication campaign/monitoring started. **b** Average increase in the number of X posts per group, starting at day -3 before the communication campaign/monitoring started, and until 10 days after. The dashed line represents the mentions detected by *Altmetric*, while the solid line represents the total, including both detected and undetected mentions. *Note:* While ‘a’ graphical representation utilizes untransformed data for clarity, the underlying statistical analyses and their interpretations are based on the logarithmically transformed datasets, ensuring the rigor of our findings

Press releases induce a relevant increase of the AAS of an article

Since the AAS includes both news mentions and X posts, PRs were expected to increase the AAS as well. In addition, *Altmetric* frequently counts the PR itself posted on PR platforms as a news mention, meaning that simply publishing it can already raise an article’s AAS. However, the exact magnitude of the increase attributable to a PR could not be predicted because the *Altmetric* algorithm, which also considers source influence and posting patterns, is not fully disclosed (Altmetric, 2023, 2024).

Our results show that the AAS of PR' +22 articles increased noticeably within the first week (68.3 points on average). This effect could be even higher, given that *Altmetric* does not capture a large proportion of news and X mentions, which are therefore not included in the AAS. In contrast, for the NPR' +22 group the AAS only increased by an average of 0.6 points (Fig. 13, Table 6).

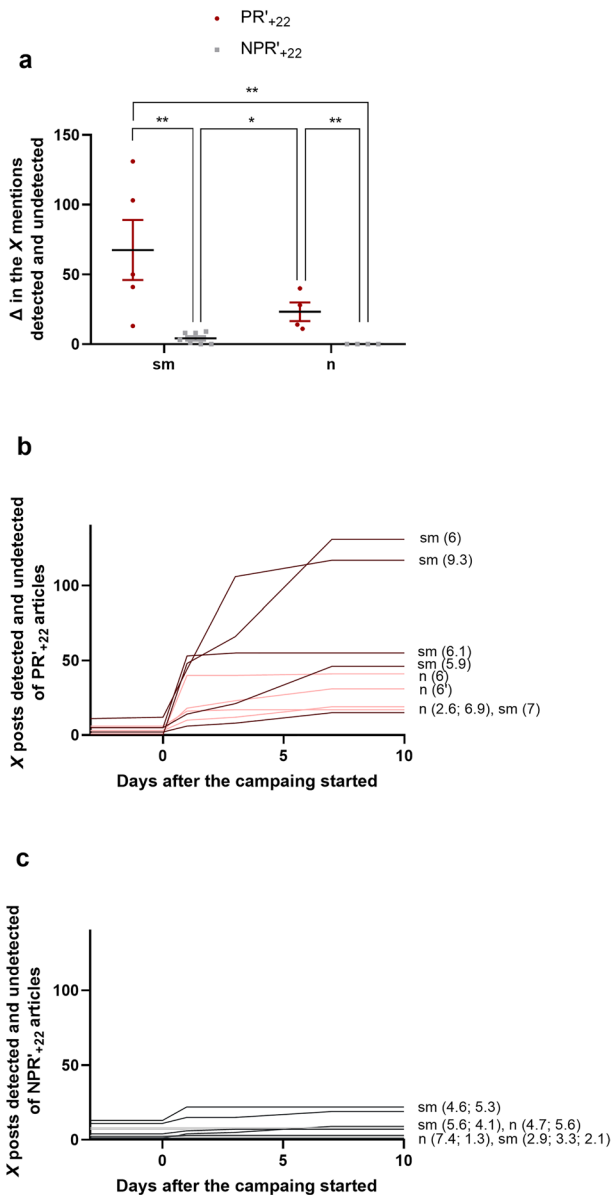
Regarding the factors influencing these changes, while no statistically significant differences were observed between the groups prior to the communication campaign, articles with a PR had a significantly higher AAS post-campaign, even after controlling for IF [$F(1,15)=53.676$, $p<0.01$] (Fig. 13, Table 6). Additionally, the analysis of covariance showed that the interaction between TIME and PR [$F(1,15)=43.668$, $p<0.01$] was statistically significant, whereas interactions involving SM were not. This indicates that PR is the main variable driving the increase in AAS.

It is important to note that the AAS of an article does not always increase over time, it can sometimes decrease (e.g. the AAS of the PR' 23sm article is higher after 1 month than after 3 months, as shown on Table 6). This may occur due to *Altmetric* readjustments or because some posts or mentions contributing to the initial score are deleted.

Isolated actions on X do not trigger major effects

We also examined the potential effect of additional dissemination actions carried out months after the initial campaign, through summer reminder posts on X (one post per

Fig. 12 A PR increases news mentions, regardless of the IF. **a** Differences among groups regarding their increase in the number of *X* posts detected and undetected by *Altmetric*, one week after the communication campaign/monitoring started. **b** Increase in the number of *X* posts in PR' +22 articles (in brackets, the article IF). **c** Increase in the number of *X* posts in NPR' +22 articles (in brackets, the article IF). *Note*: While 'a' graphical representation utilizes untransformed data for clarity, the underlying statistical analyses and their interpretations are based on the logarithmically transformed datasets, ensuring the rigor of our findings



article in August 2022). Interestingly, the effect of these one-off actions was minimal (Table 7).

Publishing in a reputable journal does not guarantee media attention

As it may also be worthwhile, we examined articles without a 22-day delay between the publication and the communication campaign or monitoring (PR' -22 and NPR' -22). Among these, two publications with very high IF had distinctly different campaigns,

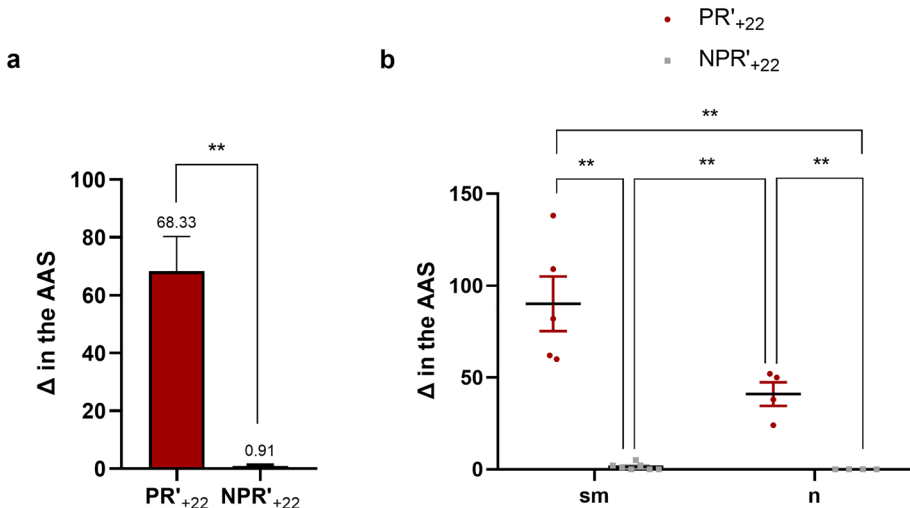


Fig. 13 A PR is a critical element of the dissemination campaign to increase online attention. **a** AAS increase comparison between PR' +22 and NPR' +22 articles, one week after the campaign/monitoring started [$t(18) = -14.225$, $p < 0.01$]. Means and SEM are represented. **b** Differences regarding the AAS increase considering the presence of a PR or/and SM, 1 week after the communication campaign/monitoring started. *Note:* While graphical representations utilizes untransformed data for clarity, the underlying statistical analyses and their interpretations are based on the logarithmically transformed datasets, ensuring the rigor of our findings

driven by the researchers' preferences rather than any assessment of general interest. For one of them (IF = 25), a PR was delivered and dissemination materials were posted on X and IG. For the other (IF = 16.6), no communication actions were carried out. In the first week, the first one was mentioned 28 times in the news (17 detected and 11 undetected by *Altmetric*), 315 times on X (178 detected and 137 undetected), and reached an AAS of 219. In contrast, the other only increased its AAS by 1 point in the first 3 months after its publication, with only two tweets mentioning it after this time (Table 8). This observation, although based on a single case, also points to the repercussions of delivering a PR to significantly increase altmetrics, regardless of the reputation of the journal where the article is published.

After a 22-day delay, the start of the campaign is no longer relevant, as long as it happens within a 90-day window

Interestingly, our results showed that once 22 days had passed after the publication of an article, the time elapsed before issuing a PR and starting the campaign was not important for reaching a relevant number of news mentions. This delay had limitations, since *Eurekalert!* only allowed posting PRs about publications that are maximum 90-day old.

Despite some articles already having X mentions before the campaign, once the PR was issued, independently of the timing, X posts and mentions in the news (and therefore, AAS) always increased immediately after, no matter how much it was delayed within the time window of the experiment (Fig. 14).

Table 6 AAS increases before and one week, 1 month, and 3 months after the PR and SM campaigns, or the corresponding monitoring period

	IF	Before	1w	Δ	$\Delta\%$	1 m	3 m
PR ['] _{38sm}	6.1	12	94	82	683%	96	97
PR ['] _{83sm}	9.3	0	109	109	-	113	112
PR ['] _{88sm}	7	1	139	138	13800%	149	148
PR ['] _{41sm}	5.9	4	66	62	1550%	79	79
PR ['] _{23sm}	6	4	64	60	1500%	71	67
PR ['] _{75n}	6	1	53	52	5200%	62	70
PR ['] _{56n}	2.6	7	57	50	714%	57	57
PR ['] _{68n}	6	12	50	38	317%	51	51
PR ['] _{64n}	6.9	4	28	24	600%	28	28
NPR ['] _{28sm}	5.3	9	11	2	22%	11	11
NPR ['] _{32sm}	3.3	1	1	0	0%	1	2
NPR ['] _{31sm}	4.6	19	24	5	26%	24	25
NPR ['] _{129sm}	2.1	1	1	0	0%	1	1
NPR ['] _{25sm}	5.6	4	4	0	0%	5	5
NPR ['] _{75sm}	2.9	1	2	1	100%	2	2
NPR ['] _{27sm}	4.1	1	3	2	200%	3	3
NPR ['] _{52n}	1.3	1	1	0	0%	1	1
NPR ['] _{90n}	5.6	10	10	0	0%	10	11
NPR ['] _{59n}	4.7	4	4	0	0%	4	4
NPR ['] _{45n}	7.4	3	3	0	0%	3	3

Finally, it is worth noting that the number of mentions in the news, X posts, and AAS for all the articles remained very stable throughout the analyzed timeline once the communication campaign started, showing no significant variations within a three-month window (Fig. 14).

Table 7 Evolution of the *X* mentions and AAS of each article after a summer reminder on *X*. *Note:* As happened in our first campaign, *Altmetric* did not detect one of our tweets, although it was correctly referenced (it is marked with an asterisk and counted in the search column)

	IF	X Before (ALT)	X 1w (ALT)	ΔX 1w (ALT)	ΔX 1w (search)	AAS Before	AAS 1w	AAS Δ
PR _{0sm}	25	213	216	3	0	227	228	1
PR _{83sm}	9.3	30	31	1	0	112	112	0
N _{32sm}	3.3	1	3	2	0	1	2	1
N _{31sm}	4.6	21	24	3	0	24	24	0
N _{129sm}	2.1	1	1	0*	1	1	1	0
N _{75sm}	2.9	2	3	1	0	2	2	0

Discussion

Sending a press release is a very effective way to be mentioned online

This study supports the idea that the optimal communication strategy to attract media attention to a scientific article is to elaborate and issue a PR summarizing its content. Both the retrospective and, most importantly, the prospective analysis show that publications accompanied by a PR received significantly higher news and *X* mentions than publications without a PR, reflected in an average gap of around 70 points in the AAS.

The prospective study indicates that 99% of news mentions occurred only after PR issuance, despite a minimum lag of 22 days between publication and PR dissemination. This addresses an important limitation previously identified by Fuoco et al. (2023), who, in a retrospective analysis, similarly found that the issuance of a PR is the main driver of media attention, although in that case causality could not be established. Our prospective design overcomes this limitation by allowing a direct assessment of causal effects.

Regarding *X* mentions, although they were present for almost all articles before the campaign, the issuance of a PR induced a pronounced surge, again showing that PRs play a key role in amplifying social attention.

If the press release is not issued before or immediately after the publication of the article, the delay does not seem to affect social attention

Although PRs are usually issued around the time of publication, our findings suggest that even when there is a delay, significant social attention can still be achieved. This extends the work of Fuoco et al. (2023), who showed that media coverage is influenced not only by PR issuance but also by factors such as publication timing, access type, and promptness of PR release, with attention decreasing when PRs are issued more than one day after publication. Our results suggest, however, that after this immediate time window, at least for Neuroscience articles, it does not matter how much a press office waits

Table 8 Mentions in the news, on X_t and AAS evolution for articles that did not wait 22 days before starting a communication campaign or monitoring. Changes in the number of mentions in the news or X are reported for one week after the communication campaign/monitoring, while AAS are reported for one week, one month, and three months after the intervention

	IF	News before	News 1w (ALT)	News 1w (search)	X before	X 1w (ALT)	X 1w (search)	AAS before	AAS 1w	AAS 1 m	AAS 3 m
PR_{0sm}	25	0	17	11	0	178	137	0	219	225	225
PR_{1sm}	3.7	0	8	13	9	80	34	5	100	101	96
PR_{8n}	6.2	0	17	22	11	15	31	7	133	133	132
NPR_{13sm}	16.6	0	0	0	0	1	0	0	1	1	1
$NPR_{0n'}$	7.9	0	0	0	0	20	0	0	12	13	14

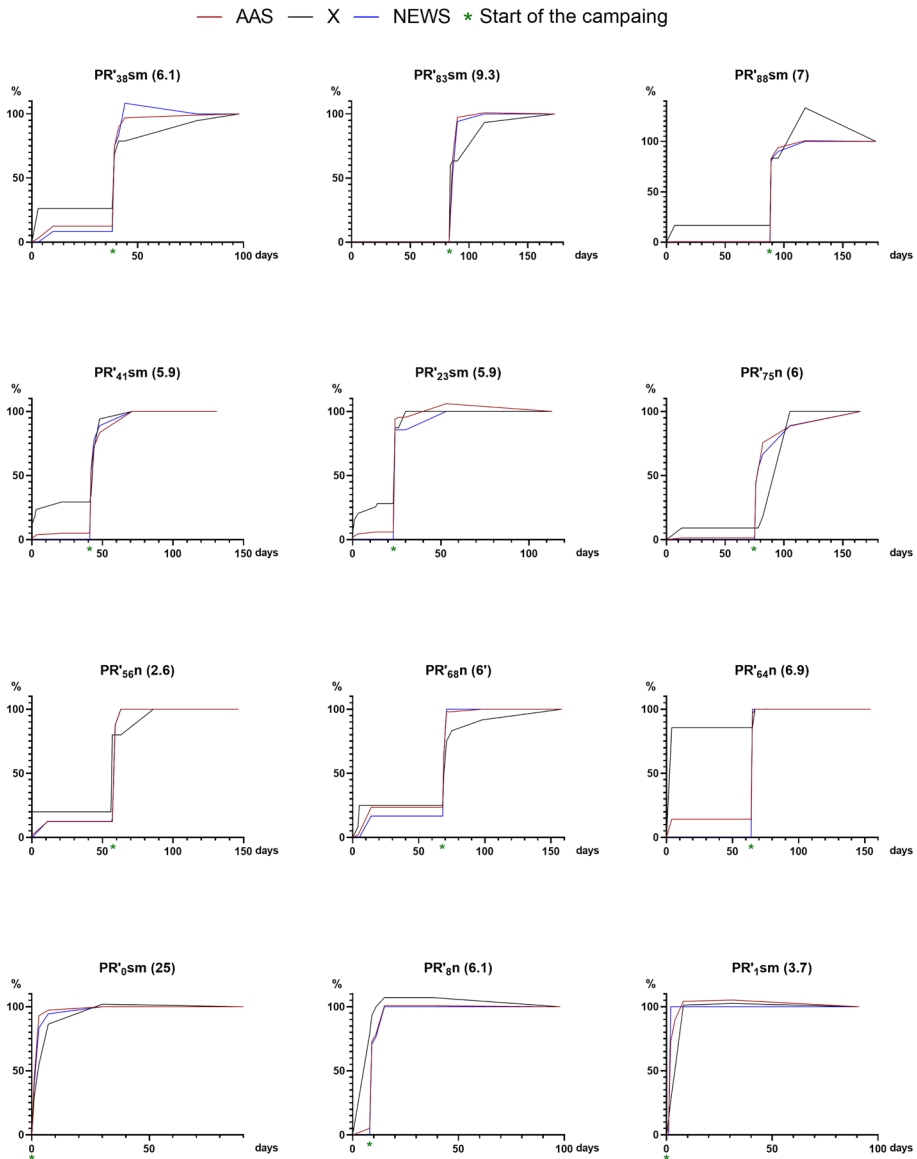


Fig. 14 *X* posts and mentions in the news increase independently of the campaign timing. % of increase in the AAS, number of *X* posts (according to *Altmetric*) and mentions in the news (according to *Altmetric*) since the publication day, for PR' articles (PR' ₊₂₂ and PR' ₋₂₂). The numbers in parentheses refer to the impact factor of each article. *Note*: News mentions are shown in their raw form, including false positives from *Alzforum*, *EurekAlert!*, and *AlphaGalileo*, since these mentions are counted in the AAS and omitting them would make the interpretation of the observed AAS confusing

to start the communication campaign, always keeping in mind that *EurekAlert!*, one of the main platforms to post PRs, only allows material from 90-day old articles maximum (*EurekAlert!*, 2018).

Once the PR is distributed, as we observed in our prospective experiment, mentions appear within the next hours or days (both in the news and on SM). This provides further clarity to the findings of Fang and Costas (2020), who demonstrated that the average news half-life (which refers to the number of days until 50% of all mentions have appeared) is 22 days. With the accumulation patterns that we observed, we suggest that, if this is the case, it is not because it takes an average of 22 days for journalists working in media outlets to prepare a piece of news, but because it must probably be the average number of days it takes for press offices to send the PR.

Single X posts have limited influence on boosting online mentions

The retrospective study shows that, for articles without a PR, there is no significant association between posts on X and the number of news items. Likewise, in the prospective study, isolated actions on X did not produce differences in the number of news mentions, X mentions, or the AAS; changes that were instead attributable to the PR.

Concerning the AAS, it is important to note that, due to the *Altmetric* weighting system (Altmetric, 2023), a substantial increase in the number of X posts would be needed to observe significant differences. However, as just mentioned, the X interventions in our study not only caused no significant differences in the AAS but also did not affect the number of news mentions or X posts, indicating that the weighting system is not the main reason for the lack of effect observed. Future studies with larger sample sizes, more intensive interventions, and a stricter X-posting schedule may provide better insights into the effects of posting on X.

It is also important to mention that engagement with posts mentioning scientific articles is generally very limited (Fang et al., 2022; Martin & MacDonald, 2020), likely due to the low quality of many tweets (Eysenbach, 2011; Maleki & Holmberg, 2024; Robinson-Garcia et al., 2017). With advances in automatic text analysis, tools such as *Altmetric* should consider the content of posts (Bornmann & Haunschild, 2018), while also offering a register not only of the number of mentions but also likes, comments, and clicks, in order to capture attention on SM more accurately (Fang et al., 2022).

Finally, it is worth noting that, due to controversial political decisions associated with Elon Musk (the current owner of X), many individuals and media outlets have recently abandoned the platform. Alternative microblogging networks are emerging, such as *Bluesky* and *Mastodon*, which operate in a very similar manner to X. We therefore expect that the conclusions of this study would likely apply to them as well as to other similar networks that may arise in the future.

Artificial intelligence tools may be useful in the future when preparing dissemination materials, although some aspects need to be considered

Preparing dissemination materials requires time and dedication. For a PR, we calculated an average of 9 and 2 h for SM posts (less for those with a PR, as ideas can be reused). This may change with artificial intelligence (AI) tools, which in the future may be a great instrument to generate first drafts of PRs, or SM posts in a more agile way. Nevertheless, beyond the existing technical limitations of AI tools, challenges pertaining to copyright, sources trustability, and the underlying training data utilized by these systems still require resolution. In fact, *Eureka!ert!* updated in January 2024 its Content Eligibility Guidelines, to expose that, due to all these reasons, they will not accept AI-generated text, images,

and other multimedia for submission and distribution via the platform (Eurekalert!, 2024). However, even if these concerns are finally settled, others may appear: AI tools helping to generate thousands of PRs a day could limit their efficacy by saturating journalists and ultimately the users.

***Altmetric* has important limitations**

According to our results, platforms providing altmetric data are not infallible in capturing mentions of scholarly articles. During our retrospective study, issues with *PlumX* were detected, leading us to discard their records from the beginning. Later, in the prospective study, we observed that *Altmetric* also is not able to capture a portion of the attention received.

As declared in the *Altmetric* website, they do not automatically capture mentions across the entire web but rely on a “manually curated collection of sources” (Altmetric, 2020), omitting part of the coverage. This, together with the methods that *Altmetric* uses to identify mentions: a mixture of link matching and text mining (Fleerackers et al., 2022), may account for the loss of data we observed in our prospective study, where *Altmetric* failed to detect at least half of our article mentions in digital news.

News stories often lack a proper citation of the article, which complicates their detection. According to our study, only 45% of the stories properly cited the research publication (namely, link to the publication, institution, authors, journal, etc.). If journalists included the article reference in their pieces, it would not only improve *Altmetric* precision but it also would benefit readers, being able to reach the original article easily.

Moreover, the language used in pieces mentioning an article, both in news outlets and on SM, may also constitute an important barrier. As noted by Ortega (2020) and Barata (2019), *Altmetric* shows a preference for English-language news outlets, due to *Altmetric* including few non-English outlets among its sources or to the greater complexity of text mining in other languages. Since many of the news items and posts referring to our articles were written in Catalan and Spanish, *Altmetric*’s ability to capture their impact could have been reduced.

We also observed that *Altmetric* may contain some misleading counts in its score. For example, they considered “mentioned by news outlets” articles appearing on online lists of papers (i.e. those listed in *Alzforum*), or PRs posted online on *Eurekalert!* and *Alphagalileo*, by communication departments, which should be filtered out.

With respect to *X* posts, those sharing a piece of news about an article, but without proper reference to the publication itself, are not taken into account by *Altmetric*. This means, for publications with a PR, that around 75% of the conversation is neglected. Researchers and institutions should be aware of this, and ensure that their posts include proper citations.

Limitations in *Altmetric* detection reduce the reliability of the AAS. Since news mentions contribute heavily to the score, deficiencies in tracking this type of attention can lead to significant misinterpretations of the attention reflected by the AAS, which makes it an inaccurate measure of an article’s actual social impact.

However, despite these limitations calling into question the reliability of *Altmetric*’s data, the indicators provided by this platform (including the AAS) can still serve as a convenient and rapid proxy for gauging the visibility of a communication campaign. When interpreted cautiously, these metrics can help communication departments compare relative performance across actions and identify which strategies work best. However, they

should not be used as definitive measures of societal impact, but rather as one component within a broader and more nuanced evaluation framework.

Recommendations for researchers and press offices

Based on our findings and the current context, we propose the following recommendations:

Prioritize PRs: Sending a PR is the most effective way to increase media attention. PRs consistently outperform SM efforts in driving public engagement. However, not all articles are inherently newsworthy or suitable for PRs. Future research could explore the factors that determine newsworthiness to better identify articles of general interest.

Timing matters, but flexibility exists: While issuing a PR on the publication day maximizes visibility according to existing literature, a delay beyond this initial window may not significantly impact media attention. Strategic timing (such as aligning with relevant awareness days) may enhance impact.

Single SM actions are insufficient: Individual posts on platforms like X have a limited impact on overall online attention. While SM can enhance researchers' visibility, facilitating networking and collaborations, direct journalist outreach through PRs remains the primary driver of public and media interest.

Ensure that digital mentions include proper references: To allow altmetric tools to accurately track mentions, researchers and institutions should include a direct citation of the article when sharing it on SM, institutional websites, or other dissemination platforms. Failing to do so may result in lost tracking opportunities and an underestimation of the article's true reach.

Limitations of the study

Our study has certain limitations that should be considered when interpreting the results. Regarding the prospective study, the sample size was modest, as the analysis was based on real communication campaigns conducted within a mid-sized research center. Although the number of articles in each condition was limited, the consistency of the results across cases supports the robustness of the observed patterns.

In addition, the study focuses on a single scientific field, neuroscience, and on publications from one research institution. This approach ensures a relevant degree of homogeneity in terms of research practices and communication strategies, but it may limit the direct extrapolation of the findings to other disciplines or institutional contexts, where communication dynamics may differ.

Both in the retrospective and prospective studies, articles vary in terms of topic, study type, journal, and access format, while remaining within the same general field. This variability reflects real-world conditions, although it may introduce factors that are not fully controlled for. Similarly, articles and PRs were issued at different times throughout the year (as shown in Table 1). For example, while previous studies suggest that timing can influence media uptake (Fuoco et al., 2023), this variability is unlikely to affect our main conclusion that PRs play a key role in enhancing the societal visibility of research.

Finally, regarding the indicators used, the IF was employed as a proxy for article quality, despite the known limitations of this metric (Plos Medicine Editors, 2006; Rossner et al., 2008). Its simple numerical approach was the most convenient for designing the statistical

analyses, although future work could benefit from incorporating more comprehensive indicators.

Acknowledgements We would like to thank professor Roser Nadal (INc-UAB) for her invaluable assistance with the statistics, the Quintanab (INc-UAB) for their priceless advice, and Maria Jesús Delgado and Octavi López (UAB Press Office) for their efforts in compiling past press releases and their continuous help. We are also deeply appreciative of the support provided by Simon Bilevych and Mariam Lepage (*Altmetric*), whose invaluable assistance in gathering essential data for this study was marked by courtesy and dedication.

Author contributions All authors contributed to the study conception and design. Data collection was performed by J. Giner-Miguel and R. Bastida-Barau. Data analysis was carried out by R. Bastida-Barau. The first draft of the manuscript was written by J. Giner-Miguel and R. Bastida-Barau, and S. Ferré and C. Barcia contributed to the final writing and editing of the article. All authors read and commented on updated versions, and approved the final manuscript.

Funding Open Access funding provided thanks to the CRUE-CSIC agreement with Springer Nature.

Declarations

Conflict of interest The authors confirm that there is no conflict of interest to declare for this study. Author SF is one of the founders of the private company *Eduscopi* from where he receives a salary. However, SF has no competing interests to declare that are relevant to the content of this article. In addition, the interaction with the members of companies managing the *Altmetric* platform and *EurekaAlert!* was purely informative and did not influence the outcome of this article.

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Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

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