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Growing Influence of University PR on Science News Coverage? A Longitudinal Automated Content Analysis of University Media Releases and Newspaper Coverage in Switzerland, 2003–2017

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Universities have expanded their public relation (PR) departments in recent years. At the same time, news media have had to cope with reduced resources. This has led scholars to assume a growing influence of university PR on a weakened journalism. However, research on this phenomenon is scarce, and longitudinal research is missing entirely. The study at hand looks at the influence of university PR on science journalism in Switzerland by measuring the effects of media releases on media coverage. It uses large-scale, automated text comparisons combined with manual content analyses. The results show that an increasing amount of media coverage is based on media releases, and that the tone of this portion of media coverage is significantly more positive toward the university. Overall, our findings suggest an increasing influence of university PR on (science) journalism.

Keywords: science journalism, public relations, media relations, higher education, automated content analysis, science communication

"Tenants of skyscrapers live longer!" "One sausage a day is unhealthy!" "Italian immigrants are more virile than the Swiss!" These and other findings headlined media releases of Swiss universities, and journalist Michael Furger complained about them lividly in the renowned *NZZ am Sonntag* (Furger, 2013).[1] "Universities publish findings like these non-stop and praise them as sound science," he wrote. "For the media, they are like fast food: quickly served, quickly consumed, but not very sustainable" (p. 5).

Furger's complaint is indicative of a trend that goes beyond Switzerland (see Dunwoody, 2014; Schäfer, 2017). In many countries, science journalism has come under pressure, as media houses have to work under strenuous conditions (e.g., M. W. Bauer, Howard, Ramos, Massarani, & Amorim, 2013) and increasingly look at science journalism as "a luxury" (Allan, 2011, p. 773) that is expendable in times of scarce resources. In turn, scientific organizations such as universities have professionalized their public relations (PR) efforts (e.g., Williams, 2015) and intensified their communication toward news media (e.g.,

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[1] These quotes were translated from German into English by the authors.

Serong et al., 2017). As a result, scholars have argued, the balance of power between science journalists and scientific organizations' PR may be shifting, toward a "strength of PR [and a] weakness of science journalism" (Göpfert, 2007, p. 215; cf. M. Bauer & Gregory, 2007).

In scholarship on strategic communication, similar diagnoses of shifting power relations between institutional PR and journalism have been made for fields beyond science (see Macnamara, 2014). But analyses assessing these diagnoses are rare, particularly ones employing longitudinal research designs. For the specific relation between university PR and science journalism, they are lacking entirely.

Therefore, we put these diagnoses to an empirical test, using a longitudinal research design comparing university media releases and science-related press coverage in Switzerland. We employ automated one-by-one textual comparison that was developed in linguistics and has mostly been used to detect plagiarism, but recently also to quantify the influence of PR on journalism (Boumans, 2018; Nicholls, 2019). In doing so, we overcome methodological shortcomings of prior research on the PR–journalism nexus. Instead of relying on self-reported survey data from journalists or PR practitioners, we compared the content of university media releases with media coverage, showing actual textual overlaps between the two in an analysis spanning 15 years, examining the period during which most of the (alleged) changes in PR and science journalism took place.

Conceptual Framework

Analyzing the Relation Between Organizational PR and Journalism

The interaction between organizational PR and journalism is one of the oldest topics in the analysis of mass communication, organizational communication, journalism studies, and communication science generally. When societal organizations such as political parties, corporations, or NGOs aim to influence public opinion or stakeholder decisions, they employ, among other instruments, strategic communication and PR (Gandy, 1982). Legacy news media, as the "master forum" of the public sphere (Ferree, Gamson, Rucht, & Gerhards, 2002, p. 9), are particularly relevant for them, rendering media relations potentially important, as they may influence which topics news media report on and how they report about those topics (Carroll & McCombs, 2003; Kiousis, Popescu, & Mitrook, 2007).

In contrast, journalism is tasked with selecting and presenting the topics and perspectives that are most relevant to the public and should therefore assess PR critically (Lewis, Williams, & Franklin, 2008). To do so, journalism has developed values and working routines that ensure a professional distance toward its sources and a critical way of dealing with them and has embedded these in the socialization of young journalists and in newsrooms (see Shoemaker & Reese, 1996). For decades, these values and procedures ensured that journalism dealt with outside sources according to its own professional standards.

Therefore, the relation between PR and journalism has been analyzed extensively (Macnamara, 2014; Sallot & Johnson, 2006). Most studies have focused on the "effectiveness" of media releases (i.e., the degree to which they are taken up in media coverage) and try to identify characteristics that make PR and media releases successful (Lee, Wanta, & Lee, 2015; Schafraad, van Zoonen, & Verhoeven, 2016). But

their findings vary strongly. Some studies show that 25% of media content is influenced by PR, whereas others estimate that 80% is (see the meta-analyses by Cameron, Sallot, & Curtin, 1997; Lewis et al., 2008). In part, this variance may be due to differences among types of organizations. It is likely that the largest influence on media coverage is executed by organizations that have the resources to produce strong and effective PR material (Lewis et al., 2008). But the strong variance in research findings is also likely due to "difficulties involved in devising solid measures to establish journalists' reliance on PR and agency copy" (Lewis et al., 2008, p. 3), and especially due to many studies relying on self-reported data from surveys of journalists and PR practitioners that may be considerably less reliable than actual measurements of PR and media content. This problem is illustrated by Larsson (2009), who shows that many PR practitioners claim to successfully influence news, whereas journalists state that they rarely rely on PR materials.

The Changing Relation Between Science PR and Science-Related Media Coverage

Many scholars assume that the relation between PR and journalism has changed in recent years—and this is particularly pertinent in the field of science communication. Science communication has been described as important because science produces the best available knowledge to face many individual, organizational, and societal decisions, yet it is complex and difficult to understand for many (e.g., Fischhoff & Scheufele, 2013). Recently, this importance is seen as rising because of fears that mis- and disinformation around science-related issues may lead to a rise of anti- and pseudoscience and in an erosion of public trust in and support for science (e.g., ALLEA, 2019).

In recent years, however, considerable changes in the broader media ecosystem have been diagnosed that fundamentally affect science communication (see Dunwoody, 2014; Schäfer, 2017). The emergence and rise of online and social media have propelled a crisis of science journalism. Science journalism, usually written by specialized journalists, reports on the results, processes, institutions and actors of science (e.g., Summ & Volpers, 2016), and, like any other journalism, is supposed to keep a critical distance to the objects of its coverage. But this is not always the case, as science journalists exhibit a relatively strong trust in science and a strong source dependence, and are under personal and source pressure to conform to scientific values (see Dunwoody 2014; Schäfer 2011). In addition, science has never been one of the strongest and best established beats in the news media (Dunwoody, 2014), and many outlets have never featured science desks. "The minor role of science journalism in publishing houses also manifests itself in staffing structures, as science journalists make up only between one and two percent of journalists in countries such as the U.S., Germany, Switzerland or Norway" (Schäfer, 2011, p. 403).

This minor role of science journalism has further diminished in recent years. As many legacy media lose audience attention and advertisement revenue, they have reduced costs by shedding staff and closing desks entirely (M. Bauer & Gregory, 2007). Specialist desks, like the science desk, have been particularly vulnerable. Often, they are "regarded as expendable," as "a luxury increasingly difficult to justify when certain other types of news will be both cheaper to produce and more popular with audiences (and thus advertisers)" (Allan, 2011, p. 773). This is a trend visible in many Western countries, like the U.S. (Brumfiel, 2009; Dunwoody, 2014), the UK (Williams, 2015), and Switzerland (Kristiansen, Schäfer, & Lorencez, 2016), where "fewer science sections and science journalist positions seem to be concentrating even further in a small number of publishing houses" (Schäfer, 2017).

These changes have led to worsening working conditions for the remaining science journalists. Although some scholars have pointed toward the positive implications of the ongoing changes—such as new online opportunities to research stories on a global scale (e.g., M. W. Bauer et al., 2013) or more immediate feedback that may further a more dialogical, participatory journalism (Fahy & Nisbet, 2011)—most scholars have highlighted problematic aspects (Friedman, 2015). They posit that journalists now work in a 24/7 news culture in which they have to process content continuously (e.g., Allan, 2011), live up to short response times, and produce a larger amount of content on more increasingly diverse channels (Dunwoody, 2014). At the same time, fewer resources are available, and science journalists' workloads are rising:

> 59% of [international science] journalists have seen the number of items they work on in a given week increase over the past five years. They are not just doing more reporting, but more types of reporting. Many are now being asked to provide content for blogs, web stories and podcasts. (Brumfiel, 2009, p. 275)

This also means that "they now have 'less time' to check facts for accuracy, while almost a quarter say they don't have enough time to make what they regard as 'adequate' checks on their facts" (Williams, 2015, p. 156).

University PR and Journalism

In turn, a pluralization of communication about science has been diagnosed (e.g., Bubela et al., 2009). A rise in PR efforts from scientific and higher education institutions, such as universities, is a key component of this trend (see Autzen & Weitkamp, 2020; Raupp & Osterheider, 2019). Not only have individual scientists realized "the value of public visibility and taken active steps to structure their own public images" (Dunwoody, 2014, p. 35), higher education institutions have realized the value of public visibility as well and increased their PR efforts (Raupp & Osterheider, 2019). They see themselves in a competition with other organizations for public attention and legitimacy in the eyes of their stakeholders (Friedrichsmeier, Geils, Kohring, Laukötter, & Marcinkowski, 2013). In this competition, university leadership often sees PR and particularly media relations as an important instrument because they assume that main stakeholders, such as politicians and funding organizations, monitor news media closely and are strongly influenced by them (Friedrichsmeier et al., 2013; Scheu & Blöbaum, 2019). This has led to universities devoting more resources to outside communication (Friedrichsmeier et al., 2013; Lessmöllmann, Hauser, & Schwetje, 2016), setting up and extending communication departments (Barathon, 2016, organizing them more professionally (Entradas & Bauer, 2019; Lessmöllmann et al., 2016), and increasingly publishing media releases (Autzen, 2014; Serong et al., 2017).

The extension and professionalization of PR departments can have positive outcomes. With their skills, PR practitioners can foster effective communication between scientists and the media and public (Borchelt & Nielsen, 2014; Peters, 2013). They may act as competent content experts and sources for scientific information for the media (Cho, 2006), and may develop "close relationships with journalists" (Cho, 2006, p. 579).

But the increasing PR efforts of scientific organizations also meet a science journalism that has always been described as source dependent (Franzen, 2011; Schäfer, 2017) and is now additionally weakened. As a result, many scholars have assumed that the balance of power between science PR and science journalism has shifted. M. Bauer and Gregory (2007) diagnose a change "from a logic of journalism . . . towards a source-driven reportage of science" (p. 33), and Göpfert (2007) a growing "strength of PR and weakness of science journalism" (p. 215). Increasingly, "time-pressed reporters [may become] reliant on information subsidies from scientific institutions, universities and public relations agencies to find material" (Fahy & Nisbet, 2011, p. 784). Scholars have argued that this affects science journalism in several ways. First, science journalists may increasingly publish university media releases directly without additional research (i.e., they may engage in so-called churnalism; M. W. Bauer et al., 2013; Davies, 2008). They may "cut and paste" media releases, making coverage "increasingly similar to institutional media releases, tellingly characterized by one specialist reporter as 'low-hanging fruit'" (Williams, 2015, p. 157). Second, they may use a celebratory, affirmative style of coverage on scientific organizations and their research (e.g., Sumner et al., 2016; Sumner et al. 2014), and deviate from critical coverage (e.g., Allan, 2011).

Research Interest, Research Question, and Hypotheses

But so far, few studies have empirically assessed the influence of science PR on science-related news coverage. Studies on science journalism have focused mostly on descriptions of science journalists' characteristics, attitudes, and role conceptions (e.g., M. W. Bauer et al., 2013; Fahy & Nisbet, 2011; Kristiansen et al., 2016), working routines and professional norms (e.g., Allan & Granado, 2011; Badenschier & Wormer, 2011), science-related media coverage (e.g., Summ & Volpers, 2016; see Schäfer, 2017), or audience interactions (see the *Journalism* Special Issue edited by Allan, 2011).

The few studies analyzing the influence of science PR on science news coverage mostly infer PR influence by analyzing the sources of science-related media coverage (e.g., Boyce et al., 2007; Lee et al., 2015), partly supplemented by qualitative interviews (Weitkamp & Eidsvaag, 2014) or surveys (Hansen & Dickinson, 1992). Hardly any studies employ input–output research designs, which compare media releases and subsequent media coverage and are the most elaborate way to analyze PR influence on journalism. It is notable, however, that the few studies that do use such designs suggest a strong influence of science PR on journalism: Sumner et al. (2014), focusing on medical research only, showed that university media releases considerably exaggerate research results, and that these exaggerations make their way into media coverage even though they do not increase the general uptake of releases by the media. In a subsequent study on health-related issues, they showed similar findings for exaggerations and caveats present in 534 media releases from science and medical journals (Sumner et al., 2016). Brechman, Lee, and Cappella (2009) analyzed 23 media releases on cancer genetics and subsequent press coverage; they also suggested that "the intermediary media release rather than news coverage may serve as a source of distortion in the dissemination of science to the lay public" (p. 453).

Despite these exceptions, however, research on the link between science PR and science journalism has considerable gaps. Few studies have analyzed this relation, and even fewer using input–output designs, but those that did stem almost exclusively from anglophone countries and focus on specific research fields only. Crucially, none of them employ longitudinal research designs, making it impossible to substantiate the

abovementioned claims about potential trends. Furthermore, they rely on comparatively small text corpora, while large-scale, longitudinal analyses are lacking.

We provide such a study by analyzing the representation of media releases of the largest Swiss university in four Swiss newspapers between 2003 and 2017. We coupled an input–output research design with a corpus-linguistic, automated, and a manual content analysis. Our overarching question was whether the influence of university media releases on science coverage has changed over time.

Generally, the influence of (university) PR on (science) coverage can be assessed with different measures (see Raupp & Osterheider, 2019). A first measure is visibility in the media, measured as the amount of media articles about a university. Such visibility is considered desirable by decision makers in universities (Kohring, Marcinkowski, Lindner, & Karis, 2013) and can be a direct or indirect outcome of media relations activities (Marcinkowski, Kohring, Fürst, & Friedrichsmeier, 2014). Second, the amount of media releases picked up by news outlets in proportion to the total amount of coverage (i.e., visibility) is of interest, indicating the influence of media relations on news coverage (also called agenda-building ratio by Boumans, 2018). Third, the amount of media releases picked up by news outlets can be compared with the number of published media releases as a cost–income ratio, indicating the effectiveness of media relations (e.g., Raupp & Osterheider, 2019). For these measures, we hypothesize the following:

H1: The influence of university media releases on science coverage has increased over time.

H2: The visibility of universities in media coverage has increased over time.

H3: The effectiveness of university media releases has increased over time.

In the wake of organizational reforms geared toward new public management, universities are increasingly expected to be, and acting as, autonomous organizations, setting their own organization goals and adopting corporate PR practices, including a stronger focus on organizational matters (M. Bauer & Gregory, 2007; Marcinkowski et al., 2014). This has led to internal frictions, however, as organizational goals may not be shared by individual members of the organization, such as scientists who may pursue their individual, scholarly, or disciplinary goals (Raupp & Osterheider, 2019). As PR departments have become closely connected to university leadership (Lessmöllmann et al., 2016), however, organizational goals have been expected to become more important in university PR (M. Bauer & Gregory, 2007). In addition, by adapting corporate communication practices such as reputation management or marketing, universities have been shown to try cultivating a positive public and media image (Borchelt & Nielsen, 2014; Lee et al., 2015). Therefore, we hypothesize the following:

H4: The evaluation of universities in news coverage influenced by university media releases is better than in coverage not influenced by university media releases.

H5: The evaluation of universities in news coverage has improved over time.

H6: *The focus on organizational aspects is higher in news coverage influenced by university media releases than in coverage not influenced by university media releases.*

H7: *The focus on organizational instead of research aspects in news coverage has increased over time.*

H8: *The influence of university media releases differs among media outlets.*

Data and Methods

Case Selection: Analyzing the University of Zurich's Media Releases and Related Press Coverage

To assess the influence of university PR on science coverage, we focused on the University of Zurich (UZH). UZH is Switzerland's largest university, regularly ranked among the top 100 universities in the world (2019 THE World University Ranking: 90; 2019 QS World University Ranking: 78), and one of the most widely covered Swiss universities in news media (Vogler, 2020). UZH is a research university with a broad disciplinary spectrum including STEM subjects, humanities and arts, and is publicly funded ("Staatssekretariat für Bildung und Forschung," 2006), giving it strong incentive to further its public and media image.

Data Acquisition

Using Web scraping, the full texts of all media releases and articles in the "news" section of UZH's website from 2003 to 2017 were retrieved (n = 5,378). In addition, the full texts of all articles from four Swiss newspapers mentioning "Universität Zürich" or common abbreviations like "Uni Zürich" between 2003 and 2017 were obtained, using the Swiss Media Database (SMD; n = 13,985). SMD is the Swiss equivalent to the LexisNexis or Factiva databases. As it is owned and provided with content by all large Swiss publishers and functions as their database for journalistic investigation as well, it offers comprehensive coverage and very high data quality.

Newspapers are still one of the main sources for information about science in Switzerland (Schäfer, Füchslin, Metag, Kristiansen, & Rauchfleisch, 2018). The selected newspapers were the most widely read national quality newspaper (*Neue Zürcher Zeitung*/*NZZ*), the most widely read tabloid (*Blick*), as well as a prominent midmarket (*Tages-Anzeiger*) and Sunday (*Sonntagszeitung*) paper (Fög/Universität Zürich, 2018). All are based in Zurich, negating biases of geographical proximity that have been shown elsewhere (Friedrichsmeier, Laukötter, & Marcinkowski , 2015). As the number of articles published annually in these newspapers has changed over the 15-year time span of our analysis, we also counted the total number of articles published by newspaper and year and use this to normalize some of our calculations.

Methodology

To measure the influence of university PR on science journalism we applied automated one-by-one text comparisons, which have recently been adapted by communication scholars (Boumans, 2018; Nicholls,

2019). To assess whether media coverage was based on university media releases, we used automated detection of similar content with an *n*-gram approach (Nicholls, 2019): We measure the overlap of *n*-grams in texts with Jaccard similarities (Lesekov, Rajaraman, & Ullman, 2014). Originating from biology (Jaccard, 1912), the Jaccard index is applied in linguistics to analyze how distinct texts in a corpus are, and it can be used to find duplicates or near duplicates of texts. A common application is the detection of plagiarism. The measure compares textual structures (i.e., "character-level similarity and not similar meaning"; Lesekov et al., 2014, p. 74). It is based on set theory and, in our case, used to measure the overlap of two sets of so-called *n*-grams, which are defined as sequences of words of size *n*. The number of *n*-grams in an intersecting set (i.e., the matching *n*-grams from two documents) is divided by the total number of possible *n*-grams from the two documents. The Jaccard index therefore ranges between zero and one. A value of zero indicates no similarity between two texts, whereas a value of one indicates full similarity (i.e., identical texts).

As we wanted to detect exact textual overlaps between media releases and news articles, we kept text cleansing to a minimum. We set all text to lowercase and removed special characters, but did not process the text further via stop word removal or stemming or lemmatizing. An analysis of the character length of news articles (min. = 147; max. = 47,019; avg. = 4,516) and media releases (min. = 145; max. = 27,092; avg. = 4,291) did not suggest difficulties with incomplete or very short/long texts. The function duplicated in R was used to remove exact duplicates from the two text corpora (same article in same outlet or duplicate media release).

We compared all possible combinations of media releases and news articles in RStudio using the "textreuse" package (Mullen, 2016), which calculated the Jaccard coefficient for each text pair. For this calculation, we broke down media releases and media articles into trigrams (*n*-grams of three words, so that the phrase "according to a study of the University of Zurich" is split into "according to a"; "to a study"; "a study of," etc.) and measured the intersecting set of these trigrams. Because of computational limits, we processed the data in batches of single years, which led to a total of n = 5,037,401 comparisons. We then reduced the data set of pairs again by only using the media release with the highest Jaccard score in relation to every media article as its most likely source (n = 13,985).

To define the level above which media releases and media articles were considered as "similar," we used breaking-point analysis with segmented linear regressions (Muggeo, 2003) with the package "segmented" in R (Muggeo, 2015). The package delivers estimates for breaking points in data sets (i.e., points where a linear relationship between two variables changes significantly). For this purpose, we ranked our cases (pairs identified with the comparison) from lowest to highest Jaccard indexes. We excluded all pairs with a Jaccard score of zero (n = 12), as no similarity was detected between the two analyzed texts, and thus no measurable PR influence was found. We then applied a logarithmic transformation to the Jaccard score, as the data were strongly skewed, and afterward calculated a regression model (n = 13,973) with the transformed index score as the dependent variable and the rank as the independent variable. The model served as a basis for the breaking-point analysis. The procedure requires an initial visual estimation of changing points (Muggeo, 2003). These estimates then serve as starting points for an algorithm for calculating exact breaking points—in our, case at ranks 11,690 (corresponding to Jaccard score = .009) and 13,466 (.030; see Figure 1).

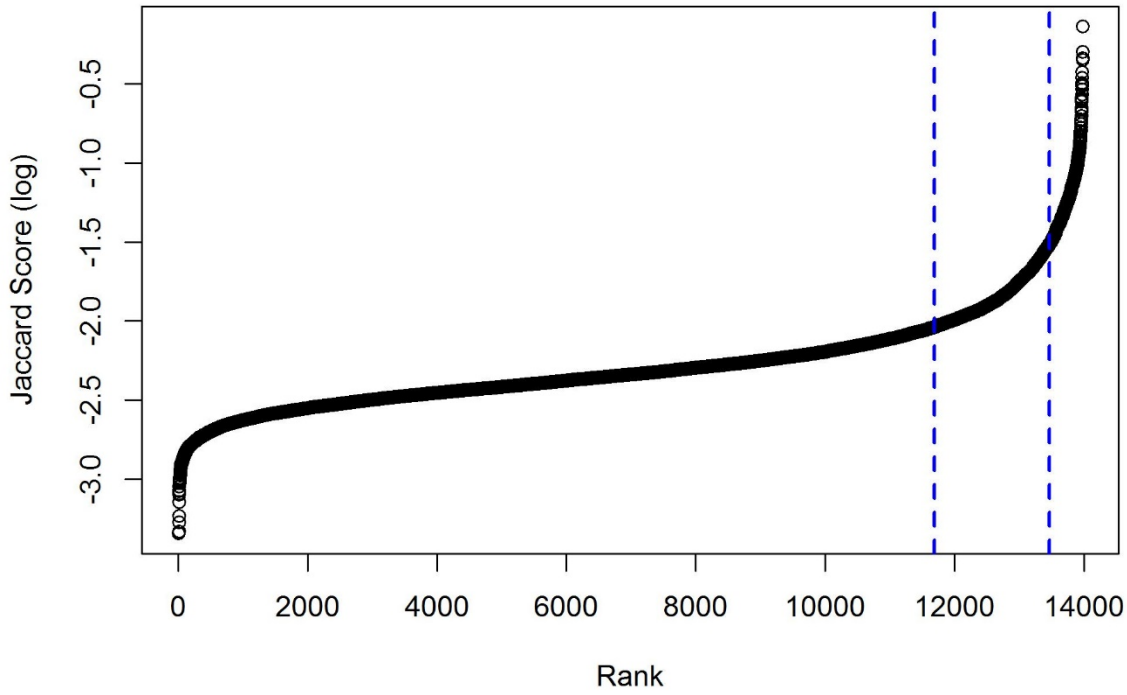

Figure 1. Log-transformed Jaccard scores and ranks used for breaking-point analysis (n = 13,690 pairs). Dotted lines indicate breaking points.

As a result, we distinguished three segments of text pairs. The first segment (n = 520 pairs) included all pairs with a Jaccard score above .030 (M = .072), the second segment (n = 1,776) contained pairs with a Jaccard score between .030 and .009 (M = .015), and the pairs in the third segment (n = 11,394; including the 12 pairs with Jaccard scores of zero) had a Jaccard score below .009 (M = .004). We then manually analyzed a random sample of 100 pairs from each segment and checked whether a match between media release and news could be confirmed. A coder identified whether the topic of the text passage concerning the UZH was identical with the topic in the media release and whether at least one identical trigram could be found. If both conditions applied, the pair was identified as being correctly matched. For the first segment, we found that all the sampled text pairs were correctly matched. The share of correctly assigned pairs in the second segment was 81%. For our analysis, we defined media articles assigned to the first two segments as based on media releases (i.e., media articles that exhibited a high PR influence). In the third segment, we found 5% of correctly matched pairs in the testing sample.

In addition, we employed a manual, standardized content analysis on a random sample of 2,000 news articles using parts of a codebook from a longitudinal study on media coverage about Swiss universities (Vogler & Post, 2019). First, we coded these articles' main topical foci, distinguishing research and organizational foci. Research foci included articles about research activities and results, or those in which UZH scientists commented on different topics based on research results (e.g., interviews, expert statements). Organizational foci were defined as articles in which the university as an organization was

central (e.g., its curricula, organizational strategies and performance [including rankings], events, finances, policy issues).

Second, we coded the tone of coverage toward UZH, distinguishing positive, negative, neutral, and balanced evaluations. Positive or negative tone was coded when UZH or its activities were explicitly praised or criticized, or when UZH was featured in a negative or positive context (e.g., in critical articles on research ethics). When positive and negative evaluations existed, the predominant tone was coded; if both were equally strong, the article was coded as balanced. If no evaluations were detected, it was coded as neutral.

This coding was done by two coders, with intercoder reliability being highly satisfactorily for both topical focus (.96) and tone (.90, both Krippendorf's alpha coefficients; tested with 10% of the news articles).

To test H1, H2, and H3 on the influence and effectiveness of university media relations and the visibility of UZH in the media, we used the broad set of articles that was also used in the automated analysis. Media relations' influence was operationalized as the proportion of media articles likely based on media releases of the total amount of media coverage. Media relations effectiveness was measured as the ratio of the number of media articles likely based on media releases to the amount of media releases. Visibility in media was calculated as the ratio of all coverage about UZH over the total coverage of the media outlets. For H8, we used this information on the level of the media outlets.

$$Media\ relations\ influence = \frac{\sum Media\ articles\ based\ on\ press\ releases}{\sum All\ media\ articles\ published}$$

$$Media\ relations\ effectiveness = \frac{\sum Media\ articles\ based\ on\ press\ releases}{\sum Press\ releases}$$

$$Visibility\ in\ media = \frac{\sum Media\ articles\ mentioning\ UZH}{\sum All\ media\ articles\ published}$$

For H4 to H7, we combined the automated comparisons with manual content analysis. Binary logistic regressions were used on the level of single news articles. Dependent variables were tone and topical focus in the media coverage. For tone in coverage, we ran four models for the different parameter values coded as binary variables (e.g., positive yes = 1 vs. no = 0). For topical focus, we used a binary variable for organizational (1) and research focus (0).

As the main independent variable, we used the information from our segmentation—that is, a binary variable that indicated whether a media article was based on a media release (1) or not (0). We used time as a second independent variable, as we hypothesized that the tone and topic were dependent on the period under review. We transferred the year into an ordinal variable for the model (1–15). We also introduced the different media as dummy variables with the tabloid *Blick* as a reference category.

The model included control variables as well. First, we controlled for the length of the articles, dividing the articles into five groups based on length in characters and including this information as an ordinal variable (1–5). We assumed that the tone of coverage would be more balanced in longer articles, as

more sources or viewpoints could be included. Second, we coded whether UZH was mentioned in the title or lead of the article as a binary variable (yes = 1 vs. no = 0). The lead was defined as the first paragraph of an article and was available for all four analyzed media outlets. We assumed that tone and topic would depend on whether the university was the core focus of an article or only part of the story.

Results

Influence of University Media Releases on Science Coverage Over Time

H1 assumed an increasing influence of university media relations on media coverage. This is confirmed by the data. Between 2003 and 2017, we see an increasing influence, albeit not with a linear increase (r = .24, p = .39; see Figure 2). Figure 2 shows a take-off period with a rapid growing influence of media relations on news coverage between 2003 and 2006, but also later periods with varying media relations influence. Furthermore, the visibility of UZH has also, and continuously, increased over time (r = .85, p < .000; see Figure 3). This confirms H2. In addition, we assumed an increased effectiveness of university media releases in H3. This is not supported by the data. Figure 4 shows that the effectiveness of media releases (i.e., the average amount of news coverage generated by a media release) decreased over time (r = −.50, p = .06; see Figure 4).

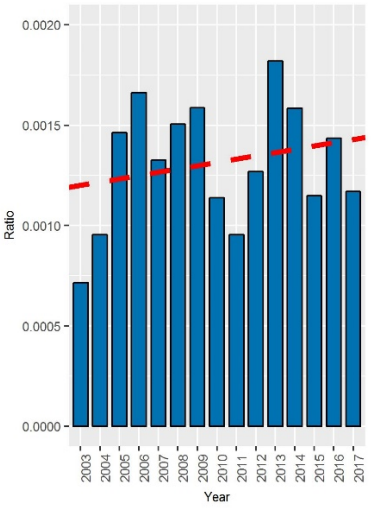

Figure 2. Media relations influence. Annual ratio of media articles of UZH based on media releases (n = 2,296) and total amount of media articles published (n = 1,752,442) with regression line (y = 1.185 + .016 * x).

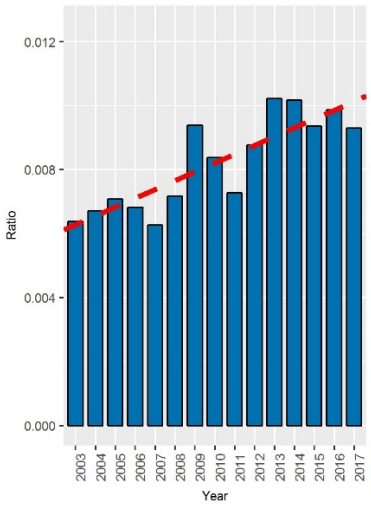

Figure 3. Visibility in the media. Annual ratio of media articles of UZH (n = 13,984) and total amount of articles published (n = 1,752,442) with regression line (y = 6.006 + .275 * x).

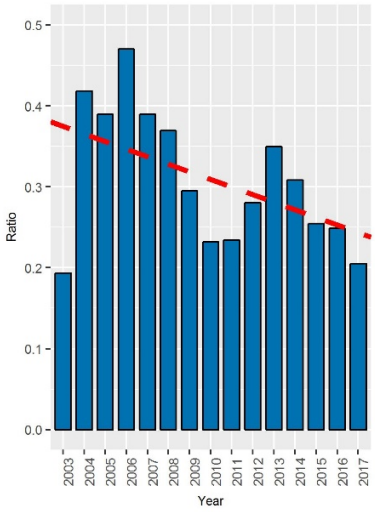

Figure 4. Media relations effectiveness. Annual ratio of media articles of UZH based on media releases (n = 2,296) and number of UZH media releases (n = 5,378) with regression line (y = .384 − .009 * x).

H4 hypothesized that the evaluation of UZH would be more positive in media articles based on university media releases compared with articles not influenced by media releases; H5 postulates that the proportion of positive media articles would increase over time due to a growing influence of university media releases.

Binary logistic regression confirms H4 (*OR* = 3.19, *p* = .004; see Table 1). It does not confirm H5, however, as no effect of time was measured for positive tone. However, time had effects on the other parameters of tone. We find a higher probability of negative (*OR* = 1.06, *p* = .037) and balanced coverage (*OR* = 1.05, *p* = .031) at the expense of neutral coverage (*OR* = 0.95, *p* = .004) over time. The interaction term PR Influence × Time was not significant, showing that the effect of time was the same for articles based on media releases and articles not based on media releases. Significant effects were measured for the different media outlets, but only for negative coverage. Compared with the tabloid *Blick*, the quality newspaper *NZZ* (*OR* = 0.25, *p* = .001) and the Sunday paper *Sonntagszeitung* (*OR* = 0.28, *p* = .042) covered the UZH less negatively. Additionally, when UZH is mentioned in the title or lead of an article, the probability that this article had a positive, negative, or balanced tone was significantly higher compared with neutral coverage. The length of an article reduced the possibility that it had a negative tone.

Table 1. Binary Logistic Regression for Tone in Media Coverage, n = 2,000.

	Positive tone		Negative tone		Balanced tone		Neutral tone	
Predictor	*OR*	*SE*	*OR*	*SE*	*OR*	*SE*	*OR*	*SE*
(Intercept)	.03***	.51	.07***	.46	.02***	.52	7.81***	.32
PR influence	3.19**	.40	.68	.64	.37*	.49	.92	.31
Time	1.00	.03	1.06*	.03	1.05*	.02	0.95**	.02
Outlet *NZZ*[a]	.78	.46	.25***	.42	1.72	.49	1.45	.29
Outlet *Sonntagszeitung*[a]	.30	.73	.28*	.63	2.05	.55	1.66	.37
Outlet *Tages-Anzeiger*[a]	.76	.46	.76	.39	1.80	.49	1.02	.29
Centrality of UZH in article	4.71***	.20	5.81***	.23	4.67***	.17	.14***	.13
Length of article	1.09	.07	.78**	.08	.97	.06	1.06	.05
PR Influence × Time	1.00	.04	.89	.08	1.07	.05	1.01	.04
Cox & Snell's R^2	.072		.059		.051		.159	
Nagelkerke's R^2	.172		.176		.111		.243	
AIC	953.696		708.590		1,155.087		1,789.771	

Note. [a] Outlet *Blick* (tabloid) is the reference category. *OR* = odds ratio; *SE* = standard error. ***p < .001. **p < .01. *p < .05.

H6 assumed that the focus on organizational aspects would be higher in news articles based on university media releases, and H7 expected that the share of coverage focusing on organizational aspects would increase over time.

Binary logistic regression confirms both hypotheses (see Table 2). PR influence has a significant effect on the topical focus of news coverage (*OR* = 2.13, *p* = .007), as articles based on media releases have a higher probability to contain an organizational focus. Time has a significant effect on the topical focus as well (*OR* = 1.03, *p* = .006): The more recent an article, the higher the probability of an organizational focus. There was also a significant negative interaction between PR influence and time (*OR* = .93, *p* = .032), showing that the topical focus was less affected by time in articles based on media releases in comparison to articles not based on media releases. Significant effects were also measured for the centrality and length of an article. Longer articles were less focused on organizational topics, whereas when the UZH was the center of coverage, the probability was higher that the focus was on organizational topics.

Table 2. Binary Logistic Regression for Topical Focus in Media Coverage, n = 2,000.

	Organizational focus	
Predictor	OR	SE
(Intercept)	1.45	.24
PR influence	2.13 **	.28
Time	1.03 **	.01
Outlet *NZZ*[a]	1.31	.22
Outlet Sonntagszeitung[a]	.47 **	.29
Outlet Tages-Anzeiger[a]	1.28	.22
Centrality of UZH in article	1.33 *	.11
Length of article	.73 ***	.04
PR Influence × Time	.93 *	.03
Cox & Snell's R^2	.083	
Nagelkerke's R^2	.111	
AIC	2,617.538	

Note. [a] Outlet *Blick* (tabloid) is the reference category. *OR* = odds ratio; *SE* = standard error. ***p < .001. **p < .01. *p < .05.

Comparing Different Media

H8 assumed differences among the four media. This is confirmed as well. First, the media differ in the distribution of articles about UZH. The university was most often covered in the quality newspaper *NZZ* (47% of all articles in our sample) and the midmarket *Tagesanzeiger* (40%), whereas the tabloid *Blick* (5%) published even fewer articles about UZH than the Sunday newspaper *Sonntagszeitung* (8%) did. When looking at the visibility of UZH in the media, second, we found that the university was covered more often in *Tagesanzeiger* (where 1.07% of all articles appearing there mentioned UZH), *NZZ* (0.82%), and *Sonntagszeitung* (0.99%). For the tabloid (0.22%), the ratio was considerably lower. Third, and most importantly, we found differences in the influence of UZH media releases on the four media. In *Tagesanzeiger* (0.19%) and *NZZ* (0.15%), the share of articles based on media releases was considerably higher than in *Blick* (0.02%) and *Sonntagszeitung* (0.04%).

Discussion

This study is one of the first to measure the influence of university PR on science journalism on the level of media content, and the first one doing so on a large scale and over time. Using an automated corpus-linguistic approach, we detected the quantity of media articles that were based on media releases and supplemented this with a manual content analysis focusing on tone and topics of coverage. This sheds light on the development of the relationship of university PR and science journalism and contributes to methodological advancement in the fields of public relations and science communication research.

Our main hypothesis was a growing influence of PR efforts on science journalism, a hypothesis that had been prominently and repeatedly articulated in scholarship (M. Bauer & Gregory, 2007; Göpfert, 2007), but had not been adequately tested. Our study indeed found an increasing influence of university media releases on news coverage, even though it differed between periods. In addition, the visibility of the analyzed university in the media increased steadily over time. This may indicate that PR influence measured on the content level was counteracted by the reduction of science sections. If universities sent out media releases, there were fewer receivers (i.e., journalists assigned to cover science news). This assumption was supported by the decrease of PR effectiveness measured as the amount of media coverage generated by each media release.

Additional manual content analysis showed that news coverage influenced by PR differed from other coverage. It was more positive toward the university (supporting H4), even though this affirmative tone did not increase over time (disconfirming H5). But the analysis of tone over time showed that negative and balanced ratings became more important at the expense of neutral coverage, pointing toward a more negative and emotional media coverage in general. Although UZH is more visible in the media and its media releases are picked up more frequently, it struggles to gain control over media coverage in general, despite increasing PR efforts. This also suggests a gap between a growing amount of favorable media coverage based on media releases on the one hand, and more critical—and more PR-independent—media coverage about the university on the other hand. The picture gets even more nuanced as media articles based on media releases also focused more often on organizational topics (as assumed in H6) and did so increasingly over time (confirming H7), both of which indicate successful PR activities.

In addition, we found differences among media outlets (confirming H8). PR influence on the quality and midmarket newspapers was more pronounced compared with the tabloid. This may partly be due to resource differences. Compared with quality newspapers, tabloids never had science desks and, thus no science pages that needed to be filled. It may also be due to university PR aiming for quality press rather than for tabloids, producing material that lends itself more easily to hard than to soft news. The fact that the Sunday press showed the lowest PR influence in our analysis supports this; the weekly publication rhythm may give journalists more time to write their stories and make them less dependent on PR. This could mean that in the future, daily newspapers with science desks, but insufficient resources and expertise—such as midmarket papers—may be especially prone to PR effects.

Overall, our results suggest an increasing influence of university PR on science journalism. This supports scholarship showing an establishing and upgrading of PR departments at universities (Barathon, 2016; Friedrichsmeier et al., 2013), an increased media orientation of university PR (Kohring et al., 2013),

and corresponds to perceptions of an accentuated economic crisis of (science) journalism in scholarship and public debate (Schäfer, 2017).

On the one hand, this has implications for the practice of science journalism and media regulation. Given the importance of science in modern knowledge societies and the proliferation of more and increasingly diverse voices communicating about science, communication intermediaries providing orientation are crucially important. Currently, however, the established intermediaries—science journalists—seem to be in crisis. In the near future, either new intermediaries or a strengthening of science journalism is needed. Currently, diverse individual and organizational models are being tested—ranging from crowd-funded to donation-based and philanthropically funded to tax-funded journalism (see Dunwoody, 2014; Schäfer 2017)—but their longevity and sustainability are still unclear.

On the other hand, more research is needed along the lines sketched in our analysis. Ideally, this research would remedy the limitations our study has. First, media releases are only one means of PR, and with our research design, we were not able to detect other, less manifest forms of influence: Journalists, for example, may ask scientists directly for statements, bypassing the PR department, especially in universities (Kohring et al., 2013). As we only looked at media outlets based in Zurich and UZH, such direct interactions between the PR departments and journalists could have led to an above-average PR influence when compared with a broader media sample. Organizational PR teams may influence media coverage in other, less manifest and subtle ways (e.g., with story placements; Zerfass, Verčič, & Wiesenberg, 2016). In addition, we could not consider the growing use of social media in university PR (Metag & Schäfer, 2017). Further research should aim to include these means of PR as well, potentially by combining text-based analysis with surveys of PR practitioners and science journalists.

Our methodological approach also has limitations. Jaccard similarities analyze "character-level similarity and not similar meaning" (Lesekov et al., 2014, p. 74). They may not detect instances when content seems similar, but contains subtle differences. The method would not indicate that an article is based on a media release if a journalist rewrote a media release in his or her own words. We may also have missed content that was induced by media releases because media such as tabloids may have used a simpler or different language. As our study has shown, a combination of automated with manual content analysis is fruitful; further research should combine automated approaches with different types of in-depth manual and automated content analysis. Such additional analyses could take up more detailed characteristics of media releases and press articles, such as potential exaggerations (Sumner et al., 2016; Sumner et al., 2014) or semantic hedges of scientific uncertainties (Jensen, 2008).

Another limitation is our focus on a single case, even though the University of Zurich is, in many respects, a typical, large research university with a broad disciplinary spectrum. Further studies should broaden this data base and analyze different institutions of higher education in different countries. This would allow scholars to benchmark the results produced by our method (e.g., the share of media articles based on media releases) and to combine them with explanatory variables on higher education and the media, on an organizational as well as on a national level.

Despite these limitations, our study offers an innovative, methodological approach to measure the influence of PR on journalism on the level of content. As some of the results remain ambiguous, the study confirms once more the complex interdependencies between public relations and journalism.

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