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Changes in media selection and framing of science news in Croatian daily press

Adrijana Šuljok

Abstract

This paper tries to 1) identify the dominant media frames of science and 2) compare media selection and framing of science-related articles in Croatian daily newspapers during two politically and socioculturally different periods: the late socialism and the (post)transition. The research methodology was based on content and frame analysis which encompassed articles on science in daily press with the highest readership between 1986–1988, and 2006–2008. The main findings indicate changes in the selection of science topics as well as in the representation of individual frames. Changes reflected not only current events in the world of science but also wider social and journalistic values, as well as evaluations of the importance of specific topics.

Keywords

Science and media

Introduction — media selection and frames

Analyses of media representations of science remain an important research subject for understanding the public image and social status of science. Many studies have analysed media coverage of science and how frames integrated into media stories contribute to the formation of the public image of science or reflect it. However, few studies deal with changes in media portrayals and framing of science topics, attempting to relate them to wider social and cultural changes. The aim of this study is to relate wider social and cultural changes to changes in media selection and framing of science news.

Why is it so important for social researchers to study media selection and framing of science, although this covers only a segment of the public image and social status of science?

Media coverage of science topics creates specific images of science and as such reflects as well as influences the attitudes toward and public perception of science [Carvalho, 2007]. Koulaidis, Dimopoulos and Sklaveniti [2001] argue that science and technological stories play an important role in the public sphere because they contribute to the formation of the public image of science. It was observed that media selecting and framing of different topics, including topics related to science, is important because it has the potential of legitimizing certain definitions, views or actors at the expense of others [Anderson et al., 2005], thus

affecting public policies. Other studies [e.g. Peters et al., 2008] and some specific cases likewise indicate that media prominence and frames may have certain political, legal and economic implications and impact the establishment of public priorities. For example, political and economic actors and other decision makers might regard media coverage of scientific institutions, researchers or scientific endeavours as indicators of their social relevance, and their willingness to (co)finance the aforementioned entities and processes might depend on it [Peters et al., 2008].

Numerous previous studies have confirmed that the media do not cover all topics equally but rather choose, filter, cover and interpret them selectively. On the theoretical and descriptive level researches in the field of selection, framing and media influence are important as they explain how journalists select topics to write about, as well as how different actors define science topics they have chosen [Nisbet, 2009]. Framing is an unavoidable concept in media and social studies in general, resting on the foundations of social constructivism and involving the process of selecting and highlighting parts of texts, phrases or ideas that could contribute to shaping public perception (Entman, 1993 according to Reis, 2008). However, despite its popularity, research on framing is still characterized by theoretical and empirical vagueness, i.e. by conceptual and operational problems, such as the lack of a commonly shared methodology for identifying frames, limiting the comparability of instruments and results [Scheufele, 1999].

To frame news is to select some aspects of reality and make them more salient in such a way as to promote the definition of a particular problem, causal interpretation, moral evaluation or a solution recommendation [Scheufele, 1999]. Individuals select, reorganize and incorporate the information thus offered by the mass media into their own existing schemes of interpretation, i.e. they actively interpret information [Priest, 1999]. Frames are, therefore, schemes for presenting and understanding news. Thus frames are, as Nisbet [2009] aptly points out, particularly relevant and interesting in communicating science, since science is disassociated from everyday lives and experiences of most laymen.

Researchers have identified a variety of factors that influence the way the media shape or frame the news, from individual to organizational and social ones. Clark and Illman [2006] identify and summarize the following factors as being important in the selection and framing of science news: journalists' interests and experience, spatial and temporal constraints in portraying a topic, target audience, events and trends within the sphere of science and technology, and broader social trends. Kunczik and Zipfel [2006] argue that journalists select news stories based on personal interests, viewpoints, concepts and interpretative frames. In other words, while certain values and viewpoints are produced in a media discourse, others are omitted [Carvalho, 2007]. Somewhat more systematic (and comprehensive) are Shoemaker and Reese [1991] and Tuchman [1978] who identified five factors that may influence how journalists shape (frame) a topic. These five factors are: social norms and values, organizational pressures and constraints, pressures of interest groups, journalistic routines and ideological or political orientations of journalists (according to Scheufele, 1999). Recognizing that the selection of topics and frames is not formed only according to journalists' personal characteristics and viewpoints, these authors take into account the wider social and organizational context as an essential element in the formation of media frames.

Starting from the premise that these social (and individual) factors define (products) frames, our starting point in this study was the assumption that in different social contexts, particularly in different socio-economic and political systems (with different values, political orientations, organizational pressures etc.), different aspects will be selected and emphasized, thus forming different frames of science topics. By merely changing the aspect of media criteria — from "socially responsible" [Robinson, 1977] or ideologically-oriented journalism in the socialist period to the present-day form of infotainment, but also the wider social, economic and political processes — it is logical to expect changes in the selection and framing of topics. Certain changes in the media coverage can also be expected from the aspect of changing relationships between science and society on a global scale, such as: questioning scientific developments and their implications, calls for socially responsible science, the democratization of science, the rise of criticism etc.

Therefore, this (and future) analysis of the media aspect, along with the usual indicators, could contribute to the better understanding of the changes in the public status of science, i.e. in attitudes and opinions formed and/or reflected by the media.

Aim and context

The main goal of this study was to identify the dominant media frames of science and determine changes in media selection (choice of topics) and framing of science stories in Croatian dailies with the highest readership. By selecting two time frames, we aim to compare media selection and science frames in two politically, economically, socially and culturally distinct periods: in late socialism, before the breakup of Yugoslavia and Croatian independence, and in the (post)transition period, after two decades of social, political, economic and media changes in Croatia.

Before describing the methodology of this study, we will briefly describe characteristics of the Croatian media system and its change. This brief overview of past and present characteristics of the media system is relevant for understanding changes in media selection and framing of science stories in the Croatian daily press.

According to some researchers [e.g. Peruško, 2013], the Croatian media system today, as in the recent past, fits well into Hallin and Mancini's Mediterranean model. Yet it is undeniable that the media, including the press, have undergone tumultuous changes during this period. Authors [Županov, 1995; Jergović, 2004] described Yugoslav press as follows. The media, although formally "social property", were centralized and controlled by the state/Communist Party (mainly through self-censorship, not prior censorship [Peruško, 2013]. As such, they were not only the source of information, but also a means of propaganda. The professionalism of journalists of the time meant balancing between the role of a party "advocate" and their public role [Robinson, 1977].[1] Journalists were social and political activists accountable to the existing social order and its political elite. However, the socialist press in Yugoslavia enjoyed greater freedom than the press

[1] Jergović [2004] claims that 90% of Yugoslav journalists in 1987 were members of the Communist Party.

in other Eastern European communist countries.[2] The Yugoslav press was to an extent exposed to market forces (e.g. expected to make profit through advertising), but limited the amount of sensationalism in the name of "social responsibility".

The second half of the 1980s was marked by the beginning of media liberalization. However, privatization (not always transparent), commercialization and market transition did not necessarily bring an increase in the quality of journalism [Jergović, 2004], among other reasons because of the widespread demand for profit which required greater sensationalism and tabloidization. According to Peruško, Vozab and Čuvalo [2013], the Croatian media system falls into the post-socialist cluster, characterized by low professionalization of journalism, low newspaper circulation, low to medium quality of public service television, high political parallelism and strong role of the state. While some researchers [e.g. Peruško, 2013] argue that the media system in Croatia continues to clearly exhibit characteristics of the Hallin and Mancini's Mediterranean model, others [Švob-Đokić and Bilić, 2014] claim that today italternates between the polarised pluralist and the liberal model. Gradual (and slow) marginalization of the state role (due to media privatization and liberalization) oscillates between protecting public interests and supporting market liberalization [Švob-Đokić and Bilić, 2014]. Political parties do not own the media/press, but some media are more inclined towards certain political options (on a personal rather than institutional level) and at times act under the pressure from politics and business. Although the regulatory media system protects the freedom of expression, independence and autonomy of the media, Peruško [2013] points out that journalists in Croatia are still unsatisfied with their level of autonomy. She also concludes that the media system, institutionalized for the first time in accordance with democratic norms and free market, was and continues to be in constant conflict with the remnants of authoritarian elements Peruško [2013].

Methods

The survey covered daily newspapers only. We opted for the print media primarily for practical reasons (availability, low cost and the possibility to expand the analysis relatively easily by incorporating earlier periods or other media forms), and also because research findings indicate that print media are still an important source of information about science [Nisbet et al., 2002]. The selection of particular newspapers was based on the principle of dailies with the highest readership in the analysed period, which resulted in the selection of different newspapers in each of the two analysed periods. Content analysis, followed by frame analysis, encompassed Croatian daily newspapers with the highest readership between 1986 and 1988 (*Večernji list, Vjesnik, Slobodna Dalmacija*) and those with the highest readership between 2006 and 2008 (*Večernji list, Jutarnji list, 24 sata*).[3]

Since individual analysis of each of the newspapers would result in a deviation from the main research problem, we shall not deal with individual analyses in this

[2] Jergović [2004] argues that the Yugoslav media from the 1950s was labelled the "freest" media in Eastern Europe.

[3] Readership data for the 2006–2008 period was provided by Ipsos Puls, an independent market and public opinion research agency, whereas data for the 1986–1988 period was based on estimates of readership levels and publication data as the only available sources of information in the selection of newspapers.

paper.[4] Furthermore, taking into account the criticism regarding the overrepresentation of elite, yet low-readership media in studies that addressed media communication of science [Evans and Priest, 1995], which resulted in sampling (different) newspapers with the highest readership in specific social and historical periods, it was not possible to compare newspapers individually between the two periods. All of the dailies with the highest readership from a given period were therefore considered as the (composite) sample for that specific period (regardless of the levels of representation of tabloids, semi-tabloids, or elite press).

The sampling was carried out using the "constructed week" method that takes into account the cyclical variations of content during the week [Riffe, Aust and Lacy, 1993]. Given the tendency, noted by numerous studies, to feature science news in weekly sections of newspapers rather than the daily ones, it was necessary to ensure equal representation of all days of the week. Furthermore, Riffe and colleagues found through comparison that the "constructed week" method is the least time-consuming and the most effective method, and in addition has the smallest percentage of errors compared to simple random sampling or consecutive day sampling. Therefore, three weeks were constructed[5] to represent each year, resulting in the total sample of 378 issues out of the total newspaper population,[6] or 189 issues for each period analysed.

The basic unit of analysis was the article referring to a scientific research activity, topic or science in general, i.e. "the article on science".[7] The working definition of science articles incorporated not only hard sciences (such as biology, physics etc.) but soft sciences as well — social sciences such as psychology, political science and sociology, and the humanities, as well as scientific-political events.

The selection process of articles followed two steps. The first step consisted of a selection based on key words (*science, scientist, research, finding, study* and their variations such as *scientists, researchers*) while the second step involved an individual examination of the selected articles and the exclusion of those which did not refer to science (for instance, the term *research* also includes coverage of public opinion polls which needed to be excluded). The primary selection of articles and the coding of manifest variables were carried out by Presscut, a media monitoring agency, and an associate independent coder, whose work was supervised and

[4] All analysed socialist newspapers were controlled by the Communist party. Vjesnik, a quality paper, had not undergo privatization and was closed down in 2012. Slobodna Dalmacija, a regional newspaper, was one of the most widely read dailies in the former Yugoslavia (especially in 1980s). All analysed post-socialist press are in private ownership. Večernji list, a half tabloid, has undergone privatization and is today officially owned by Styria Medien AG, although there is speculation that a right wing politician might be behind the newspaper. It is considered a conservative newspaper. Jutarnji list, a half tabloid, launched in 1998, is owned by Europapress Holding, a Croatian media company. It leans more toward social democrats. 24 sata, a tabloid, was launched in 2005 and is owned by Styria Medien AG.

[5] According to Stempel, 12 (i.e. 14) days or 2 constructed weeks are sufficiently representative of the entire (calendar) year (Stempel, 1952, in Riffe, Aust and Lacy, 1993, p. 135). Accuracy, especially in studies that cover periods longer than six months [Riffe, Aust and Lacy, 1993, p. 138], could be improved by using two or more constructed weeks.

[6] The sampling was carried out using the Random Calendar Date Generator programme (www.random.org). The programme was developed by dr Mads Haahr from Trinity College, Dublin.

[7] The content analysis included articles published in all sections and annexes, with the exclusion of promotional material, letters and questions from readers, denials or articles of similar character.

checked by the author of this paper.[8] Further coding and identification of media frames were carried out by the author, with subsequent verification of intracoder reliability using a subsample (5%) of articles.[9] In total, 885 articles were selected.[10]

Since the subject of this research was media frames of science and their changes, we were primarily interested in science-related aspects. With an aim to analyse the dominant frames integrated into media stories contributing to the formation of the public image of science or reflecting it, we started from previous studies that had described a set of frames recurring in science stories and debates. We were, however, open to new frames discovered during analysis.

The researcher applied the most widely used approach to analysing frames — manual detection of frames in articles. More precisely, apart from the content analysis, we also used qualitative (textual) frame analysis to critically examine the text and identify/revise news frames in the coverage of science. After closely reading science articles and identifying the thematic macrostructure and the central concept, the researcher also examined other aspects of the text (style, tone, rhetoric) to identify and interpret frames and findings.

As several typologies of frames appearing in articles about science have already been developed, we chose to apply (and test the suitability of) the typology developed by Gamson and Modigliani in their study of media presentations of the Chernobyl disaster (1989) and further adapted by Nisbet [2009] (Table 1). We decided to use Nisbet's typology for two reasons. The first was to ensure possible comparability in future studies. Nisbet [2009] strongly advocates the use of already existing frames for comparability across studies. The second was because Nisbet argued that these sets of frames appear to reoccur, or, in other words, these frames consistently appear in science policy debates.

However, while classifying the empirical material, we encountered difficulties since this typology did not fully encompass all of the frames appearing in Croatian newspapers. For that reason, while collecting and coding the materials, we simultaneously developed alternative frames and modified the typology.

[8] In order to verify the reliability of this selection method, an initial test was carried out using a subsample of articles, with the aim of establishing whether articles that were hand-selected by the author matched the articles selected using this method: the result was a high degree of agreement.

[9] Intracoder reliability was assessed within time and financial constraints. In other words, the complexity of the topic and extensive training needed to ensure the identification and coding of subtle message demanded more economical approach. Intracoder reliability coefficient (r) was high (0.93 or higher) for analysed items.

[10] In the socialist period (N = 475) articles on science occupied on average 1.7% of the total daily papers and the difference between the newspapers was not statistically significant. In the "current" decade (N = 410), the share of science articles in the total area has significantly decreased (sig. = 0.003) compared to the previous period, to only 1.2% of the total. The difference between the dailies was not statistically significant. The average number of articles on science published in a single issue of newspapers was 2.51 in the socialist period, while in the (post) transition period 2.17 articles were published on average [Šuljok, 2011].

Table 1. Frames in policy debates [Nisbet, 2009].

Progress	science topics are presented as an improvement of the quality of life or a solution to a problem, as social and scientific progress.
Economic development / competitiveness	Science topics are presented as economic investments, market benefits or risks, and as local, national or global competitiveness.
Morality / Ethics	science topics are presented in terms of right or wrong, respecting or crossing ethical limits.
Scientific / technical uncertainty	science contents are presented as a matter of expert understanding, as what is known versus unknown, invoking or undermining expert consensus, through scientific evaluation
Pandora's Box / Frankenstein's Monster / runaway science	science topics are presented as a call for precaution in face of a possible impact, out-of-control activities, the works of Frankenstein, or as fatalism.
Public accountability	research in the public good or serving private interests
Conflict / strategy	science topics are treated as games among elites, battles of personalities or groups.
Middle way / alternative paths	science topics are presented as finding a compromise between conflicting, polarized views.

Source: Nisbet [2009].

Results and discussion

Changes in the thematic structure of articles on science

Before we present the results of the frames analysis, we will focus on media selection and the thematic structure of articles on science, because the selection of science topics reflects not only current developments in the world of science, but also certain social and journalistic values and estimates of the importance of certain topics.

Overall, over forty thematic areas had been identified and later grouped into 15 categories (Table 2). The last category and a relatively numerous one — Other — is comprised of a variety of activities which, due to the lack of frequency and homogeneity, cannot be classified into new categories or merged with the existing ones.

Table 2 shows that, in terms of frequency, the most represented science topics in dailies with the highest readership in the pre-transition period were stories on scientific research events, such as conferences (primarily those taking place in Croatia, followed by events in other republics of the former Yugoslavia, as well as elsewhere) and overviews of domestic scientific publications (16.4%). Scientific conferences covered by the daily press were most often related to humanities and social sciences (especially to philosophy, history, literature, sociology and political science) or to biomedical sciences. Former media interest in conferences on humanities and social sciences can be accounted for by the fact that some of these conferences were primarily devoted to doctrinal or ideological contents (e.g. the "Class and nationality in Tito's thoughts" conference). In other words, the media and scientists were also instruments of spreading an ideological message which, in times of friction among Yugoslav republics and the strengthening of nationalistic feelings, had an added importance for the preservation of socialist Yugoslavia. In today's dailies the percentage of stories on scientific conferences and publications is several times smaller, not as a consequence of a smaller number of research

Table 2. Thematic structure of an article.

	Total (N=885)	1986–1988 (N=475)	2006–2008 (N=410)
Health: illnesses and treatments	16.3%	**15.6%**	**17.1%**
Health: prevention/nutrition/healthy life	16.0%	5.7%	**27.8%**
Presentation or announcement of scientific conferences and publications	9.9%	**16.4%**	2.4%
Space exploration and astronomy	6.8%	8.2%	5.1%
Domestic science and technology policy	6.2%	8.8%	3.2%
Portrait of a scientist and his work	6.0%	8.2%	3.4%
Popular psychology/psychology	5.2%	2.3%	8.5%
Archaeological discoveries	3.4%	4.8%	1.7%
Nature — wildlife/biodiversity	2.9%	1.7%	4.4%
Genetic/molecular research	2.5%	,8%	4.4%
Sexuality	2.3%	1.1%	3.7%
Environmental topics/risks (e.g. climate change)	2.0%	2.3%	1.7%
Presentation of a domestic scientific institution	1.8%	2.3%	1.2%
Nuclear power and weapons	1.7%	2.5%	0.7%
Other	17.0%	19.3%	14.7%

activities (research projects and publications have a trend of growth), but rather as a reflection of decreased media and public interest, ideological influences or relevance.

Next in terms of the frequency of representation of science topics in the socialist media are health topics, primarily those dealing with illnesses and treatment methods, or research on pathogens and the development of medicaments. Health topics are even more frequent in today's dailies; however, the emphasis today is no longer on illnesses and treatment, but rather on prevention and in particular on a "healthy" diet. This shift towards topics suggesting that prevention and a healthy lifestyle are essential for an individual's health certainly reflects the shift in medicine which has been increasingly promoting personal responsibility for one's health and prevention programs for various diseases, especially the most common ones. This thematic shift at the same time reflects the shift towards the cult of the body, towards a society which is becoming increasingly preoccupied not only with healthy lifestyle but with physical appearance as well, as Petersen and Bunton indicate [1997]. High frequency of "scientificised" health topics in both periods is not surprising given their greater applicability and the fact that they are potentially important/close to everyday life.

Other relatively (and roughly equally) covered topics by the socialist media include domestic scientific and technological policy, space exploration and astronomy, and portraits of scientists.

The domestic scientific and technological policy articles covered topics such as the (unfavourable) position and (insufficient) funding of science, the lagging behind global trends, and the role of science in the "general social development". The

dominance of (sub)topics just mentioned is not surprising taking into account that the analysed period coincided with several events: 1) the Yugoslav economic crisis in the early 1980s, manifested, among other things, in reduced government spending on science; 2) thematic conferences of the Communist Party, and 3) the outlining of the plan for the development of scientific and research activities for the 1986–1990 period.

On the other hand, this analysis covers the period when the current economic crisis had just begun (2008) but had not yet escalated and therefore could not have had any significant effect on the intensity of the media coverage of scientific and political topics. However, unlike the socialist media in which the position and role of science in social development was (although primarily rhetorically) a significant and relatively common socio-political topic, this topic now appears to be irrelevant to the media, as well as politically and socially, and has lost its former rhetorical importance, as partly corroborated by the data collected. Tentatively, it could be argued that the socialist system was more devoted to the positive and important role of science, at least on an ideological and rhetorical level, meaning that it relied on science as an important factor of social and economic progress more than contemporary Croatian society does today. Former (socialist) countries had high expectations from science and technology for the development of socialism and contribution to a socialist society [Macrakis and Hoffmann, 1999]. These expectations stemmed from the belief that science would solve social and economic problems, foster modernization and prevent the lagging behind developed western countries. On the other hand, recent research suggests that people in less developed countries tend to see science as a progressive force but are very sceptical and pessimistic about science's contribution to economic and social development today [Gonçalves, 2000]. The explanation for this dualism as well as for the weakening of interest in domestic scientific and political issues partly lies in the growing awareness of the distinction between the level of principle and practice, between science and its application, in other words, in the fact that science has not proven to be an essential factor in economic and social developments of these countries, as Gonçalves indicates.[11]

In addition to scientific and political topics, the table shows that the late-socialist media often reported on space exploration and astronomy. Although media interest in these topics has remained relatively high to the present day, there is no doubt that the former print media reported on such events more intensively, primarily due to the events happening in the world of science at that time, but above all because of the disaster of the US space shuttle Challenger which triggered a series of articles on the causes and consequences that event would have on further space exploration. Greater media coverage of that topic can be explained by the symbolic competition between the USSR and the USA in the exploration and "conquest" of space, although the space race had been declaratively suspended.

Portraits of scientists and their work likewise constitute a group of articles less and less found in today's dailies. Portrayals of scientists as a media topic largely included articles marking the birth and death anniversaries of domestic and, quite often, foreign scientists. This type of articles was common in sections such as *Time*

[11] The science in these countries was not able to establish itself as a main engine of socio-economic development due to very low levels of investment in science, as well as the lack of preconditions needed for cooperation of science and economy (transfer, commercialization, etc.).

travel, which have in the meantime disappeared or lost importance. Although their role was to a certain extent symbolic and a matter of status, they did have an important role in popularization, promotion and education. Portraits of researchers and their discoveries have since given way to trivial matters and news about celebrities, i.e. to the media criteria by which experiences of "instant stars" (bordering banality) are more important than Nobel Prize laureates.

The table also shows that both the socialist and the (post)transition media expressed considerable interest in popular science and psychology topics, whereas their frequency has increased in the meantime. This trend is in line with media changes towards the routinization of journalism and more trivial and sensationalistic topics, as well as the general tendency to report on science topics only if they are "weird and crazy", have "implications for the individual" or are associated with major developments in the political or economic sphere [Hansen, 1994, p. 116].

In recent times, media emphasis has also changed when it comes to topics such as genetic or molecular research and nuclear energy. An increase in the number of articles on genetic research in the last period is a logical consequence of the dynamics of scientific research and progress in this field (e.g. the human genome project), as well as of the industrial interest in the field of genetics. In contrast to the increased media interest in genetic research, interest in nuclear energy is decreasing. However, since this study covered the period after the Chernobyl accident, but not the period after the Fukushima disaster of 2011, bias is inevitable. Despite that, it is assumed that reporting on risks, consequences and public attitudes towards nuclear technology was at its peak in the 1980s because of the proximity and the sheer scale of the disaster, as well as the "unfamiliarity" with the event.

The remaining topics accounted for a minority of articles on science and will therefore not be individually analysed. All of the above, as well as the data presented in the table, indicates that the media choice of topics, i.e. filtering and selection, varied and reflected to a certain extent current developments in the scientific community and society, but it even more reflected the media and social values and interests of a particular period.

Changes in media frames of articles on science

The primary reason researchers approach the analysis of media frames of science-related articles from different starting points lies in the fact that the theoretical elaboration of this concept remains hugely underdeveloped. In this study, we started from Nisbet's typology of frames which we have then modified. The typology tool we thus obtained, the classification of frames, is a combination of segments of Nisbet's typology and of frames drawn from the empirical material. For 83 articles we were not able to determine the dominant frame, as science topics they covered were secondary and were thus excluded from this analysis. In total, 802 articles were analysed and grouped into seven main frames (Table 3).

The scientific (and social) progress frame encompassed, similar to Nisbet, all articles in which science was portrayed as a progressive activity contributing to the scientific community, therefore to knowledge, society or the individual. Most of the articles did not separate or distinguish between the scientific and the social progress. Since

Nisbet's typology groups them together, we applied uniform classification as well. Although categorical distinction might be useful, as it would differentiate between scientific and social progress, it would be artificial because (insufficiently sophisticated) media coverage does not recognize or differentiate between the two.

Table 3. Share of media frames.

	1986–1988 (%)	2006–2008 (%)
Scientific progress	57.7	76.8
Scientific controversies	7.2	7.5
Scientific failure/ underachievement	4.1	2.0
Political and ideological function and social status	18.7	2.0
Scientific accountability	3.2	0.8
Ethical aspects and risks	1.5	3.7
Sciencetainment	7.7	7.3

The majority of media articles about science in both periods, as shown in table 3, emphasize this aspect when talking about science. The percentage of articles in the socialist period portraying science in terms of progress, discoveries, applicability of results and innovations that would ensure better life was over 57%, going up in recent times to as much as three-quarters of all articles! This refutes globally more and more frequent theses about the degradation of the image of science through an increase in the negative and critical coverage of science. This frame being very broadly defined, at least two forms of emphasizing scientific progress have been identified within it. Science was mainly covered in terms of scientific discovery, success or progress in general (globally) or through the reputation and success of domestic science.

For example, on the anniversary of the discovery of radiation the socialist media published articles emphasizing the importance of that scientific knowledge with the words "this has shaken the very foundations of science" ("Discovery of radiation", 26.7.1986, *Večernji list*). There are plenty of similar examples in the analysed textual material. "Grand discovery", "major step forward in finding the answer", "discovery of epochal importance", "discovery that could shed light on mysteries" and similar phrases were common terminology used by journalists to describe scientific endeavours. Such sensationalist over-emphasis and glorification of scientific successes is not surprising and is, along with the tabloidization and media sensationalism, supported by scientists who uncritically accept the principles and criteria of today's media. Recent research suggests that some scientists support or even encourage overstatements to attract the attention of the public or potential funders (Weingart, 1998; Lawrence, 2007; Peters et al., 2008; Nerlich, Elliot and Larson, 2009). It is therefore not surprising to have a higher proportion of these frames today. However, numerous articles adopted a more moderate rhetoric — for example, "the results might be useful for further research", "it has been scientifically proven for the first time" — but in these writings too science was framed so as to point out certain success or contribution, therefore progress.

The second sub-group of articles framed as progress consists of articles about scientific and research endeavours and achievements of domestic science. Their uniqueness lies in putting national scientific research endeavours in the context of

international recognition or comparison with the global scientific community. They highlight achievements of domestic scientists and scientific excellence in specific research fields. In the socialist period 20.2% articles were framed as domestic scientific (and social) progress. Highlighting domestic scientific successes was present, for example, in articles on jubilees or anniversaries of national institutions. In this way domestic scientific and research institutions were presented as reputable and internationally significant, but also as institutions with visionary projects. For example, the Institute for Migration ("Promotion of the Institute for Migration and Ethnic Studies", 15.01.1988, *Večernji list*) was characterized in the media as "one of the first institutes for migration", "the biggest research institution" of "general social and international importance". In addition to highlighting the success of domestic institutions, researchers' contributions in specific fields and the scientific importance of publications were also emphasized, suggesting the presence of global trends in domestic science. For example, the media reported that "foreign speakers praised the achievements of Yugoslav experts" at an international congress ("Recognition of pioneers in superconductivity", 17.10.1987, *Vjesnik*) or that "successful integration into European and world medical achievements" was taking place ("Congress of Croatian physicians", 04.11.1987, *Večernji list*).

The national dimension of scientific progress is present today as well, but to a much lesser extent, among other things due to poorer coverage of domestic science. In the 2000s presenting science as a success and progress of national science accounts only 7.8% of the articles, compared to a 1/5 of articles in the socialist period. In other words, although we have noticed an increase in stories framed as progress in science generally, "national science" progress frame have become less common in recent years. Nevertheless, today's media are specific in that, when reporting on the successes of the domestic scientific and research sector, they refer to the so-called *scientists-returnees* from the diaspora or to Croatian scientists working abroad ("Returnees pushing science forward", 07.03. 2008, *Večernji list*). Media space is given to other domestic scientists as well, but less frequently and their work is not covered on a continuous basis or they are not always mentioned by name (e.g. "Physicists from Ruđer Bošković Institute involved in the discovery of the smallest nuclear molecule", 02.02.2006,*Jutarnji list*). In some ways, the media today "acknowledge" only global (competitive) science as true, relevant science worth of media coverage.

An antipode to the scientific progress frame is scientific failure, blunder or lagging behind in science. This is a newly created category that rarely appeared in the media, but is important because a certain number of articles emphasize precisely the cases of falling behind or underachieving in science. This category includes articles which, for example, stressed the incompatibility of domestic science with international scientific standards (e.g. "Following the world science", 24.6.1986, *Vjesnik*), as well as articles critically portraying Croatian scientific institutions as and not at all progressive. The refusal to accept Miroslav Radman, Ph.D., to the Croatian Academy of Sciences and Arts (HAZU) was portrayed as a scandal, as a true mistake by an important Croatian scientific institution; articles published in *Jutarnji list* and *Večernji list* (20.05.2006) criticized the Academy and discussed this disgrace, as well as the non-existence of domestic scientific excellence. Although some of these articles may be described as scientific controversies, conflicts even, we identified this frame as lagging behind in science because the most pronounced aspect was the denial of scientific excellence (with)in the Croatian scientific community.

The same frame appeared in media reports on scientific failures of other countries (e.g. the Challenger space shuttle disaster or the failure of the Federal Republic of Germany to launch a space mission). By comparing the two periods, we noticed that the scientific failure frame had appeared far less frequently in the (post)transition news stories than before, which can be accounted for by the absence/visibility of major scientific underachievements, different media approaches in selecting topics and a consolidated progressive image of science.

Scientific controversy and uncertainty is the next frame we borrowed from Nisbet's typology. It includes articles portraying science as controversial or uncertain, whether in terms of knowledge, research process, consequences or the conflict of interests. The table shows the share of these frames has not changed over time, although recent international studies suggest an increase in controversial stories, which does not support the thesis of the *medialization of science*[12] according to which the share of controversial frames should be on the rise. Media reports falling into this frame indicate that:

- scientific knowledge is not yet final — e.g. *Večernji list* ("Vitamins E and K" 29. 08.1986) reports that "we clearly still do not know the real truth and the role this vitamin plays", referring primarily to the uncertainty and the lack of consensus regarding scientific knowledge;
- there are unsolved scientific "puzzles" — article "Body destroys own cells" concludes that the causes of high mortality rates from the Spanish influenza largely remain a mystery (*Jutarnji list*, 29.09.2006);
- some new discoveries have undermined previous findings — e.g. research refuting the current scientific belief about the causes of heart attack ("Breaking the myth of the managerial image of Americans — the heart strikes equally", 06.09.1987, *Večernji list*);
- there are different research theories or explanations or conflicts between two research points of view — for example, scientists' disagree whether playing computer games represents an addiction or not ("One in seven players addicted to video games", 26.06.2007, *24 sata*).

Controversy is particularly interesting when it comes to the conflict of interests, although the Croatian daily press do not mainly report on science in this way. The causes for this are likely to be found in the Croatian social context in which industry (private interests) and science still function as two separated spheres and in which questioning the conflict of interests has not been established as a cultural norm. An article published in *Slobodna Dalmacija* "Nicotine the same as heroin" (24.06.1986) is an example of the controversy of science, showing the contrasting views of an industry, i.e. the tobacco industry claiming that smoking is not an addiction, and of other researchers who deny that. An example from recently published newspapers is an article on the development and use of the popular antidepressant Prozac, but referring to the pharmaceutical industry's selfish interests to achieve the highest possible profits ("20 years of Prozac" 16.05.2007, *Jutarnji list*). It is interesting to note

[12]The presumption of an increasing controversy was taken from Schaefer' literature overview and his identification of medialization dimensions [2009], although it has not been confirmed by his empirical study.

that the Croatian media have not portrayed the conflict of interests as an ethical issue, but primarily as a conflict of opinion. Generally speaking, no quantitative or qualitative changes in the share and characteristics of controversial frames between the socialist and the democratic period have been observed.

The next frame was also borrowed from Nisbet's typology and is based on problematizing the *ethical aspects* of scientific work and the application of research results. It includes articles which emphasize ethical issues of scientific research and discovery, especially the application of their results. There is a series of articles questioning the legitimacy of scientific endeavours unacceptable to certain segments of society on moral grounds. For example, *Večernji list* and *Slobodna Dalmacija* (10.07.1987) published two articles titled "Giving birth for therapeutic reasons divides Italy" and "Moral issue over programmed conception: born just to save his sister" indicating an ethical dilemma and conflicting public attitudes towards giving birth to a new child for therapeutic purposes. Naturally, similar ethical dilemmas are found today as well. In the article "Human-animal embryo approved", Večernji list (21.05.2008) informs the public that Great Britain has allowed the use of such embyos in the research of remedies for various diseases, despite the objections from the Church and the opposition. *Jutarnji list* (07.03.2008), for example, published an article titled "Scientific breakthrough leaves scientists simultaneously delighted and concerned: device projecting human thoughts", pointing out the dangers this finding may bring due to the possibility of finding out people's thoughts without their consent. All of these texts underline the protection of human rights and the dignity of human beings in scientific research endeavours and the application of their results.

In addition to the preoccupation with the protection of human rights and dignity, the ethical frame also includes articles covering deviations from commonly accepted research practices, such as plagiarism and falsification of results. Comparing the media practice during the two social and historical periods, we observed a somewhat higher presence of ethical aspects in news articles today than before, which may indicate the beginning of a re-evaluation trend in science.

The scientific accountability (and warning) frame is a new frame we developed to include articles portraying science and scientists as responsible actors in research, interested in helping the world, either with specific actions or by drawing attention to potential problems. In these articles scientists warn about problems such as algal blooms, ozone depletion and climate change, or launch an appeal to help certain areas, people and research endeavours, or want to hear the voice of the public. Science is portrayed implicitly, or framed as "conscientious, socially reflexive and good", but we cannot talk about explicit stereotypes. Thus, the article titled "Miserably performed generational task" (18.06.1988, *Vjesnik*) brings scientists' critical views on the ecological crisis in the society, while another article was devoted to the humanitarian work of a scientist ("Scientist Ivan Đikić visits Debra association", 01.12.2007, *Večernji list*). This frame was dominant in a very small number of articles, both today and in the past.

The ideological and political frame is also a new frame derived from the collected empirical material. A brief glance at the representation of this frame clearly shows large differences between socio-historical periods. The share of ideological and political frames is far more pronounced in the media coverage of science in the

socialist period, reflecting the social system, current problems and media and social values of that era. Internal political frictions, indicators of strengthened nationalist currents undermining the "brotherhood and unity" of the country, helped reinforce their dominance. The ideological load and the role of society and the media as propaganda tools, as well as the rapid social and political changes, are all manifested in the news stories on science. The media and science today have largely been freed from political and ideological functions, causing this frame to be on the verge of vanishing, and not surprisingly so.

The ideological and political frame dominates newspaper articles in which science is used as an instrument for propagating certain ideological and political issues and views, that is, in articles with a certain degree of indoctrination. For example, reports on certain domestic scientific conferences in the socialist media had strong ideological and political connotations, presented in such a way as to encourage Yugoslav integration and cooperation among (all) republics, promote the success of the socialist political system or condemn ideologically undesirable events, behaviours or opinions. An example of the ideological and political frame is an article in *Vjesnik* questioning the grant of privileged pension to Ivan Supek, a distinguished scientist — physicist and philosopher, because his work, i.e. the book *Heretic on the Left*, spoke out against the wellbeing of society or more precisely against the idea of brotherhood and unity ("Following the proposal to grant an extraordinary pension: Why give privileges to I. Supek, too?", 25.11.1986). The political and ideological frame is visible also in articles on the SANU Memorandum (Serbian Academy of Sciences and Arts) which contributed to the disintegration of Yugoslavia and the strengthening of nationalist views, which was against the spirit of "brotherhood and unity" of all peoples in Yugoslavia. The same day (10.31.1986) *Večernji list* published an article titled "Memorandum — moral destruction" while *Vjesnik* published "Memorandum against the interests of Serbs".

This frame was observed not only in articles on the national context but the print press also reported on the appeals by Russian scientists to review the scientific truth about Stalin, on Russia's opening to the West (following the case of Sakharov, the Russian physicist and human rights activist whose freedom of movement was restricted by the USSR) and similar topics. Within this frame it is possible to identify a special subgroup of articles consisting of articles which express a particular ideology, but regarding the social importance of science. These articles "examine" the value of science and the investment in science, but with an underlying message that science is important for achieving economic progress and competition.

Although the ideological and political frame, similar as the frame of (national) science progress, manifest a decreasing trend, these two frames sharply differ. Progress frame (including national science) emphasis scientific activity, while the ideological and political frames instrumentalize science for political purposes in such a way that scientific activity is almost secondary. What both frames have in common is that periodically they are propaganda tools that ("should") contribute to the perception of national identity.

We called the last frame *sciencetainment* after the model of *infotainment* — a media trend which increasingly insists on the entertainment aspect when informing the public. This frame includes news stories in which scientific knowledge, the research

process, the application and the contribution are in fact of secondary importance, while the primary role is given to "interesting facts", funny trivia, in other words to entertainment. These media reports frame science by emphasizing its funny side, highlighting funny facts, either by the selection of research topics or by "deviations" from the scientific process or by trivializing the scientific knowledge. For example, an article in *Slobodna Dalmacija* (24.06.1986) "American scientists on Antarctica receive food: eggs arrive by parachute" informed the public about an insignificant, yet funny fact. Or an article in *24 sata* (11.12.2007) which informed about an "official search for Santa Claus", i.e. about a "research" expected to find out how fast Santa Claus would have to travel to deliver all gifts on time. There are many more examples, from bats — the world's biggest alcoholics, monkeys "going crazy" in a spacecraft, a "scientific finding" that people and robots will fall in love with each other, to an article informing that people become 10% prettier after two beers. It is interesting to note that the share of these frames remained the same between the two compared periods, which does not mean that sensationalism, the *yellowing* of journalism or the trivialisation of science articles were as present in the past as they are today. Some articles (primarily in more recent years) which we included in previous categories also had features of sensationalism and entertainment, but it was not their main frame.

Conclusions

The main purpose of this study was to contribute to the better understanding of the changes in media selection and framing of science news, or (indirectly) to the understanding of the attitudes and opinions towards science formed and/or reflected by the media. The findings of this study confirm the initial hypothesis regarding the expected changes in the selection and framing of science news. In summary, the 1980s were marked by contents which, except being practical and important for the individual (health topics), had a specific ideological and status role but also played a role in the popularization of science (portraits of scientists). The selection of topics suggests that the socialist press, in accordance with Robinson's thesis [1977], less often opted for sensationalism and soft news in the name of "social responsibility" and political and ideological goals, relying more on "socially responsible reporting" but actually balancing between "the party lawyer and the public role of the media". Today, science-related stories in the media are focused primarily on health and entertainment, leading us to conclude that the changed social, and especially the media context (criteria, values, editorial policies etc.), has been reflected in the selection of topics. Science-related topics, and in particular science policy-related topics, have been vanishing from daily newspapers, contrary to global trends of bringing science closer to the public, democratizing it and encouraging public participation.

When it comes to dominant media frames, the mere need for modifying Nisbet's typology already indicates that general media models cannot be uncritically introduced into the research of the Croatian media reports on science, i.e. that a single model cannot equally successfully explain features of the media image of science in different societies. Not only do media frames identified in Croatian articles on science differ to a certain extent from the "Western" ones, they also differ in the frequency of occurrence between the two periods analysed. The most widespread form of framing articles on science — highlighting progress, identified by international studies as well — is becoming an increasingly dominant frame, undermining the thesis of a growing criticism of science (also noticed by Nelkin

[1995]). The lack of criticism and controversy can be partly explained by the journalistic approach, i.e. superficial and uncritical treatment of the science news. Furthermore, the disappearance of the "ideological and political" frame suggests a reduction of ideological and political importance of science. The media practice during the socialist regime, the political ideology and the interference in editorial policies, egalitarian values and other features of that system substantially differ from today's. The media today are not (as) exposed to political pressures as before; they are more exposed to market pressures, as reflected in tabloidization and sensationalism. Socio-cultural and political characteristics have also undergone transformation and other topics and frames emerge as relevant.

In other words, the changes that have occurred, both in media selection of science topics and in framing, can only be understood by taking into account the changes in the social and media context, since social and political events have an impact on reporting in general, including the reporting on science. The selection of scientific and research issues reflects not only current developments in the world of science but also wider social and journalistic values, as well as evaluations of the importance of specific topics. For this reason future frames ought to be studied and created taking into account the accompanying social and media context.

In conclusion, the social evaluation of science, facilitated by the media, is undergoing a certain shift, visible in an increased marginalization of certain types of topics and the selection of others, although science remains predominantly positively evaluated. Or, in other words, if media reporting on specific topics is taken as an indicator of the social relevance of science, then science in Croatia, and in particular scientific and political topics, are losing importance, regardless of the fact that overall we still cherish a positive attitude towards science, as suggested by other domestic surveys as well [Prpić, 2007].

The relevance of this study lies in the fact that research was carried out in a (post-) transition country, of which very little is known in terms of characteristics of media reporting on science, as "public understanding of science" studies are mostly dominated by analyses in highly developed, English-speaking countries (as noticed by Schäfer, 2012). Also, this study's grasp of the socio-historical dimension provides insight into the importance of understanding (changes in) the social context where media patterns and particular scientific interests are formed. And finally, the patterns of media selection and framing, and the national/social contexts in which they are formed differ, as they differ from those characteristic of highly developed countries, which results in certain specificities and cross-cultural differences in the media coverage of science.

Broader generalizations on the relationship between science, the media and the public in Croatia would require an even more complex, comprehensive and long-term undertaking, such that would include an analysis of other types of media as well as a research of the roles, practices and perceptions of journalists, scholars and the public.

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Author

Adrijana Šuljok received her PhD in Sociology (2011) with the thesis "Media Representations of Science and Social Changes in Croatia". She is a research associate at the Institute for Social Research, Zagreb, Croatia. Her field of research is sociology of science, especially public understanding of science and science communication studies. E-mail: adrijana@idi.hr

How to cite

Šuljok, A. (2015). 'Changes in media selection and framing of science news in Croatian daily press'. *JCOM* 14 (01), A02.

ISSN 1824 – 2049. Published by SISSA Medialab. http://jcom.sissa.it/.