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MEDIATIZATION OF SCIENTISTS: PROCESS, INDICATORS, IMPACT

Tallinn 2024

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The dissertation was accepted for the defence of the degree of *Doctor Philosophiae* in Audiovisual Arts and Media Studies by the Doctoral Studies Council of Social Sciences of Tallinn University on April 6th, 2024.

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The defence will take place on September 18th, 2024 at 16 o'clock at Tallinn University's room M-648, Uus-Sadama 5, Tallinn, Estonia.

This research was supported by the European Social Fund's Doctoral Studies and Internationalisation Programme DoRa, Kristjan Jaak Scholarship, Research Fund of the Tallinn University and BFM Fund for Research and Development.

ISSN 1736-3632 (printed publication)
ISBN 978-9949-29-733-7 (printed publication)

ISSN 1736-783X (pdf)
ISBN978-9949-29-734-4 (pdf)

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25 Narva Rd
10120 Tallinn
www.tlu.ee

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LIST OF PUBLICATIONS

The dissertation is based on these four papers, which are referred to in the analytical overview by Roman numerals:

I. Scheu, A. M., Olesk, A. (2018). National Contextual Influences on Mediatization: The Comparison of Science Decision Makers in Estonia and Germany. *Science Communication*, 40 (3), 366−392. https://doi.org/10.1177/1075547018766917.

II. Olesk, A. (2019). Mediatization of a Research Group: The Estonian Student Satellite ESTCube-1. *Science Communication*, 41 (2), 196−221. https://doi.org/10.1177/1075547018824102.

III. Olesk, A. (2019). Media coverage of a strongly mediatized research project: the case of the Estonian satellite ESTCube-1. *Mediální studia / Media Studies,* 13 (1), 7−27.

IV. Olesk, A. (2021). The types of visible scientists. *Journal of Science Communication*, 20 (2). https://doi.org/10.22323/2.20020206.

Author's contribution:

I. The study was initiated and designed by the co-author. I was responsible for data gathering in Estonia. The data was analyzed and the article written in collaboration with the co-author.

II.–IV. These studies have been fully initiated, designed, conducted and written by the author.

ABSTRACT

Increasingly, “the demand to communicate with the public has become part of [scientists’] legitimating exercises” (Weingart, 2012). Visibility of scientists is usually perceived positively in the science communication framework and efforts are made to support their public communication efforts, e.g., by providing media training to researchers.

The impacts of a close relationship with media are evaluated more critically in the theoretical approach known as mediatization. According to this framework, an extensive adaptation with media logic can distort crucial processes within a social institution and thereby alter its basic social function (Franzen, Weingart & Rödder, 2012). While science has been considered more resistant to extensive mediatization (Rödder & Schäfer, 2010), institutional changes connected with promotion culture have been noted (Väliverronen, 2021).

This thesis investigates how publicly visible researchers in Estonia are negotiating the tension between the societal and institutional pressure to communicate with the public, and the impact of those inevitable, potentially critical adaptations to media logic that are needed to gain and maintain media visibility. It is guided by the understanding of individual-level mediatization as a process where media adaptions are undertaken based on actors’ beliefs about how the media operates and what accommodations will provide the actors with desired media visibility (Marcinkowski, 2014).

The thesis is guided by three research questions: 1) What elements facilitated the mediatization process of the investigated researchers? 2) What indicators can be used to describe the mediatization characteristics of individual scientists? and 3) What impacts can be associated with the individual and collective media-related adaptions?

The empirical results of the thesis are based on 22 in-depth interviews with Estonian scientists (with special focus on the research group that developed the Estonian satellite ESTCube-1) and content analysis of ESTCube-1’s media coverage.

According to the results, the intense mediatization observed among ESTCube-1 team members was strongly supported by project leadership, participation in media training workshops and regular collective reflections on media interactions.

The differences in attitudes and practices among the team members guided the characterization of five dimensions in which the relationship of the scientists to media logic produce functional differences. These dimensions allow defining qualitative indicators that are used to characterize typical patterns of mediatization which, in turn, also describe functional niches in the science-media ecosystem that scientists can occupy. This conclusion has implications for the way scientists are being trained for public communication.

The visible scientists themselves predominantly perceived their adaptations to be beneficial and in line with the commitment to public communication. However, the skills of researchers in exploiting media logic can, when accompanied by other autonomy-reducing changes in media, impair journalism's ability to report science in a critical way.

In summary, by exploring the process of becoming a media-engaged scientist and identifying key characteristics of mediatization among scientists, this thesis offers a more nuanced understanding of public visibility and the mechanisms underlying the different types of media visibility. It also contributes to the theory of mediatization by providing an analytical framework to understand and evaluate micro-level mediatization in the context of science.

ACKNOWLEDGEMENTS

This has been a long journey, full of distractions. The number of people who have supported me during this odyssey is longer than it is possible to list here.

I am thankful to Professor Kaja Tampere who invited me to Tallinn University and saw me ready to join the PhD program. ECREA and Nordmedia conferences and summer schools gave me many good friends and were crucial in shaping my identity as a researcher. Dr Andreas Scheu was my first guide to mediatization theory and was very kind to host me in Münster and co-author the first article. Some of the highlights of the thesis process have been the insightful and thought-provoking discussions I have had with Professor Pille Pruulmann-Vengerfeldt and Marju Himma-Kadakas. Numerous Tallinn cafes have tolerated my writing sessions. In some of them Berit Renser has been an invaluable co-student. Many colleagues both at Tallinn University and Office of the President of Estonia have made efforts to give me time to work on the thesis (although I was not always able to use it purposefully).

I would like to thank my supervisors for their patience. I am also thankful to all researchers who agreed to be interviewed. With many of them we have been able to continue inspiring discussions about communicating science. I have received great mental support from many PhD students who have shared their journeys, experiences and frustrations in Twitter.

This thesis is dedicated to all who did not lose faith that this thesis will ever be finished.

Foremost, I am grateful to Maarja, who came into my life at the right moment and has been sharing the greatest burden.

And, of course, to Aadam and Liivi, the most delightful distractors of them all.

INTRODUCTION

„[D]ramatic changes in science and in communication are forcing changes in science communication, and, in the process, in the kind of scientist who gets communicated. Today's visible scientists . . . are unique to the contemporary media and their audiences" (Goodell, 1977, p. 6).

These lines, published in 1977, capture an important aspect of the science-media relationship. The observation of the deep connection between the characteristics of media and the characteristics of scientists visible in media is just as valid and insightful today as it was in the 1970s when Rae Goodell investigated the visible scientists of her day. While the four decades since Goodell published her book *The Visible Scientists* have seen further dramatic changes in science[1], in media and in science communication, I will argue in the thesis that the core mechanism that produces visible scientists still functions in the same way. That mechanism, adapting to the rules of media in order to manage media interactions more effectively, has as much to do with the characteristics of the researchers as it does with the properties of the media. The way that science is presented in the media – the topics and the individuals, the tone and the depth – is greatly influenced by this process and the pattern of interactions between scientists and journalists.

Today, we are able to give a name to this process and its outcomes – the dynamic relationship of media and other spheres of the society are captured by the theoretical concept of *mediatization*, emerging as a major social theory in the last decade. There are various approaches to mediatization but, in this study, mediatization of science is understood as the transformation of science when it "adhere[s] to the formats of media for their function and practices in society and culture" (Lundby, 2014, p. 11). The thesis sets its focus on the scientists' side of that interaction and looks at the "institutionalization of new patterns of social interaction" (Hjarvard, 2014, p. 202) that occur when interaction with journalists or the perceived need for media visibility induces changes in the attitudes and practices of individual researchers or a research group – changes that potentially affect many other aspects, not just those directly related to media.

There are both practical and theoretical reasons for understanding how scientists get engaged with media and perform in that arena. Theory-wise, this will advance a mediatization approach in science. The practical aspect is strongly related to some of the core questions of the field of science communication: how to make relevant

[1] In English, the term 'science' traditionally refers to natural and hard sciences only and, therefore, science communication also tends to focus on these fields. The Estonian equivalent 'teadus', however, has a broader meaning, also encompassing social sciences and humanities, with relevant extended understanding also applying to science communication, 'teaduskommunikatsioon'. Whereas in this thesis, all interviewed researchers work in fields captured by English 'science', I believe that the same principles of mediatization also broadly apply to social science and humanities. This thesis encourages a wider interpretation of the word 'science'.

scientific knowledge available in the public sphere and engage scientists in societal debates.

In the past decades, science communication has gone through fundamental transformations in terms of its perceived role in society, the actors involved, and the formats used (Bucchi & Trench, 2014). It has developed from an activity seen as improper, "tainted", or even damaging by the scientific community to "a responsibility" of every scientist (Gregory & Miller, 2000). We have witnessed reconsiderations in the main focus and target problems of science communication, shifting from enhancing the public understanding of science to fostering public engagement, dialogue and a democratic debate (S. Miller, 2001). There has been a rapid expansion in the number and types of science communication activities, supported by dedicated funding, a policy push and general institutionalization of the field.

Yet, an observer reading texts about media coverage of science might easily assume little, if anything has changed: accusations of inaccuracy, sensationalism, and oversimplification (Secko et al., 2013) are as common today as they were in any decade of the second half of the 20th century. The dissatisfaction with the science-media relations forms an important part of the "improvement" discourse that seems to be one of the guiding themes of science communication discussions (Gregory & Miller, 2000).

The validity of these complaints and the reasons the media treats science the way it does have been dissected in numerous books and studies (e.g., Bauer & Bucchi, 2010; Granado, 2011; Hansen, 1994; Nelkin, 1995) but from the perspective of this thesis, the persistent nature of such complaints reveals two important things. First, that media is perceived to be relevant in setting the public agenda and shaping the image of science. Its capability to reach large audiences is associated with great impact, both for good and bad. Effective science communication cannot function without media. The special focus on media is also reflected in the number of studies that analyze science communication in the media (Schäfer, 2012).

Second, the fact that tensions between scientists and media arise and persist supports the basic premise of the mediatization theory, that these fields are autonomous social institutions with their own 'logics'. This follows the idea of the functional differentiation of society by Niklas Luhmann, according to which we can say that media and science are two autonomous subsystems of a society, which have – to fulfill their core functions in the society – specific function, performance, and reflection operations (Luhmann, 1977). These are reflected, for example, in the routines and practices of evaluating, processing and presenting information. The discord in evaluating how science is presented in the media can often be considered a result of a failure to recognize these differences.

Bringing the worlds of science and media together has long been the task of science journalists as professionals skilled in navigating both environments.

Recent years have also brought a new wave of additional intermediaries – public information officers, science communication specialists etc. Yet, there have always been scientists who are capable and willing to engage with the media directly. Increasingly, most scientists are encouraged to have media skills, as indicated by the large number of communication training programs and guidebooks dedicated to improving media communication of science. Scientists themselves also report feeling the responsibility to communicate their work (e.g., Besley & Nisbet, 2013; Loroño-Leturiondo & Davies, 2018; Peters, 2013). At the same time, the observation that Gregory and Miller made in 2000 still seems to hold true: "[W]hile science communication research has engaged critically with the journalistic agencies of science communication, it has only infrequently engaged critically with the role of the scientific community in science communication" (Gregory & Miller, 2000, pp. 107–108).

The visible scientists come in many shades. Goodell (1977) described people who are outspoken, often pushing a social or political agenda with their media appearances. Some popularizers, like Brian Cox or Neil deGrasse Tyson have risen to a celebrity status (Fahy & Lewenstein, 2021) for their charisma, societal resonance and ability to explain any topic however complicated. Väliverronen (2001) and Horst (2013) further differentiate scientists depending on the role they fulfill in media, e.g., representing their institution or criticizing claims by other researchers.

What is common to many of the scientists – to a greater or lesser extent – is the characteristic that is referred to in the opening quote of the thesis: they are influenced by their relationship to the media. Many of them display an understanding of how media works and how communication to the public needs to be different compared to communication with their scholarly peers. Those most visible are "uniquely attuned to the needs of the mass media" (Fahy, 2017, p. 1020), recognizing public attention as a valuable resource.

While the dominant attitude of the scientific community towards the media presence of scientists has become more favorable, there is still a fair amount of ambivalence about it (Rödder, 2012). Some forms of media engagement are considered more acceptable by fellow scientists than others. For example, scientists not speaking in an institutional role or as the author of a respectable scientific paper can risk being perceived as doing self-promotion (Rödder, 2012). Visibility seeking, henceforth, is associated with adaptions to increase the likelihood of media visibility and, at the same time, can undermine the core values and practices of science that grant science its special position in society (Weingart, 2012). Similar adaptions with implications on the autonomy of the social institution have been observed, among others, in politics (e.g., Meyen et al., 2014; Strömbäck, 2008), religion (Hjarvard, 2011), sports (Frandsen, 2016) or education (Breiter, 2014).

Therefore, the question of scientists in the media is an inherently ambivalent one. From one perspective, we want scientists to appear in the media as this increases the

impact of science in society and guarantees that science can continually function by lending it legitimacy. Significant efforts are made to increase the visibility of science and scientists in the media, especially in times of crisis such as the COVID-19 pandemic. The other perspective warns that intense interactions can backfire if the adaptions put media visibility above the criteria that previously determined the value of research and researchers (Weingart, 2012).

These tensions highlight the practical need for research on the dynamics of scientists' media practices. Mapping the process of becoming a media-engaged scientist and identifying key characteristics of mediatization among scientists allows the impacts associated with the mediatization process to be weighed. Aligned with various aims of science communication and the expected roles of scientists in public engagement activities, this could help to guide media communication efforts involving scientists.

The relevance of this discussion in the Estonian context is exemplified by a statement from Mailis Reps when she was the Estonian minister for education and research. According to her, society does not hear enough about the achievements of researchers or about the possible new applications of research; explaining the importance and impact of science in an understandable and relatable way is the task of scientists, research organizations, funding organizations, [technology] developers and policy makers alike ("Minister Mailis Reps: Eesti teaduse valupunkt on ühiskondliku kokkuleppe puudumine," 2018)[2]. This means that despite the rapid development of science communication in Estonia in the last decade (Olesk, 2020), including the activities of the EU-funded national science communication programs TeaMe and TeaMe+, and the considerable increase in science coverage in the media, there is a political expectation of even more efforts.

This thesis also contributes to the theory of mediatization by providing an analytical framework to understand and evaluate micro-level mediatization in the context of science. The difficulties of operationalizing mediatization have been a frequent point of concern for both the proponents (Lundby, 2014) and critics (Deacon & Stanyer, 2014) of the theory. In part, these difficulties stem from the fact that mediatization is often considered a macro-level process or even a metaprocess similar to globalization or secularization (Krotz & Hepp, 2011). This thesis is guided by the institutional approach of mediatization that mainly focuses more on changes on the meso-level (institutions and organizations) by describing and evaluating their adaptions to media logic, i.e., formats and practices of media institutions (Altheide, 2013). This, however, begs the question of how to operationalize media logic as there are strong arguments that this cannot be pinned down to one universal set of formal or informal rules (Couldry & Hepp, 2013).

[2] Original quote: „Paraku ei kuule ühiskond teadlaste saavutustest ega teadustöö võimalikest uutest rakendustest piisavalt. Teaduse olulisuse ja mõju selgitamine inimlikult ja arusaadavalt on meie kõigi ühine kohus – see on teadlase, teadusasutuse, rahastaja, arendaja ja poliitikakujundaja ülesanne."

The issue could be overcome by understanding mediatization as a mental process that is based on perceptions of media logic, as Marcinkowski (2014) points out. According to his concept of mental mediatization, adaptions are undertaken based on actors' beliefs about how the media operates and what accommodations will provide the actors with media visibility. Considering these micro-level adaptions as the mechanism of mediatization gives us the tools to evaluate the characteristics of mediatized individuals, groups and organizations. It also opens the way to investigate how these micro-level adaptions transform into mediatization processes on the meso- and macro-level.

Existing studies that characterize micro-level mediatization processes are mostly undertaken in the area of politics. Hence, the proposed indicators in these studies are based on characteristics that are specific to politics (e.g., election campaigns) and cannot be directly applied to evaluate micro-level mediatization in science. Therefore, there is a need to develop an approach specific to the context of science.

The aim of this doctoral study is to investigate mediatization taking place on the level of individual scientists, and specifically to explore it from three angles:

1) **the process of mediatization, i.e., the conditions and drivers that led the investigated researchers to become mediatized; (Articles I, II and IV)**
2) **individual variations in the characteristics of mediatization and their functions in the science-media relationship; (Articles II and IV)**
3) **the broader effects of changed interaction patterns on science and media; (Articles I, II and III)**

To build an understanding of the micro-level mediatization processes and characteristics, the thesis uses the case of the research group that developed the first Estonia satellite, ESTCube-1, to which I had close access as a journalist and an informal communication consultant. As I bring out in Article II (p. 198), "the team started the project with no previous media experience, followed by a rapid transformation into a media-prominent research group". The visibility granted to the project by the media not only stemmed from the novelty value of the project (being the first ever satellite built in Estonia) but also from the project members' skilled interaction with journalists, as I experienced personally in my work as a science journalist. That was an indication the team had undergone or was undergoing mediatization. Their lack of previous media experience meant that the group developed all their media-related practices from scratch, making it possible to map the process and allowing the contributing elements to be brought out more clearly than would have been possible with other publicly visible scientists or research projects.

At the same time, I acknowledge that ESTCube-1 was not a standard research project and conclusions from studying this case may not be easily applied to all scientists. The project had many features, from its educational aims to the funding scheme,

that make it an exceptional case. Still, I argue that studying ESTCube is useful for illuminating the mediatization process since some of its specific characteristics also make the mechanism of mediatization exceptionally clear. The differences between ESTCube-1 and other research projects may be in the intensity of the mediatization processes but, in essence, the process itself is universal, since "it is guided by media logic, not the logic of the specific scientific project" (Article II, p. 217). Afterall, the push for media visibility of scientists is globally driven by similar concerns (Weingart & Joubert, 2019) – attracting students to STEM fields or increasing public visibility of science and public appreciation for science.

For better context, the case of ESTCube-1 is supported in this thesis by other lines of research: it also describes the media-related adaption by research institutions, the mediatization characteristics of other visible scientists in Estonia, and provides analysis of media content about the ESTCube-1 project.

This thesis comprises four individual studies:

Article I compares how decision-makers in science perceive the mediatization of science organizations in Estonia and Germany and how they describe the influences and impacts of that process. This study gives an overview of mediatization on the organizational level and shows how the individual perceptions of researchers who are in the decision-making positions at their institutions contribute to such processes.

The other articles explore the various angles of mediatization using the example of the research group that developed and built the satellite ESTCube-1. **Article II** focuses on how the team members acquired media skills and what impact they believe their interactions with media had on them personally as well as the project. **Article IV** explores the media-related perceptions, attitudes and practices of the team members and differences between them. Given the lack of a scheme for evaluating micro-level mediatization in science, the study proposes a set of indicators that allow such evaluation. The indicators are tested on another group of visible scientists to develop a rough typology of mediatized scientists. **Article III** looks at the press releases and media coverage of the ESTCube-1 project to see how the mediatized interaction patterns might reflect in the media texts produced about the satellite. All studies (except Article III) use semi-structured interviews as the method of empirical data gathering. In total, I made 22 interviews with Estonian researchers for these studies: eight with ESTCube-1 team members, seven with people in decision-making positions at research institutions, and seven with people who can be considered visible scientists. The choice of the in-depth qualitative interview as a research method is rooted in the understanding of mediatization as a process that is, to a great extent, consisting of and driven by mental perceptions of individual actors (Marcinkowski, 2014). Therefore, we need to study these perceptions to understand and evaluate mediatization, and qualitative interviews are a well-established tool to access people's "perspectives, perceptions, experiences, understandings, interpretations, and interactions" (Mason, 2004, p. 1021). Article

III provides supporting material to the interviews by analyzing media texts about ESTCube-1, both quantitatively and qualitatively.

The analyzed media texts include seven articles that I wrote as a journalist – this is approximately 10% of the total print coverage of ESTCube-1. My meetings with them as a journalist often grew into more general discussions about communication science and interacting with journalists. Some of the team members also participated in a media training that I gave. While I was never directly involved with preparing or running specific communication activities with them, these close engagements with the ESTCube team make it necessary to reflect on my position as a researcher since my own contribution to the public visibility of the ESTCube-1 project has been significant. Section 2.4 provides a detailed description of my interactions with the ESTCube-1 team and discusses its potential impact on this study. Here, I would like to highlight that the focus and main research questions of my thesis are greatly influenced by my experiences as a journalist. The research question about the process of mediatization was informed by the observation made during frequent interactions with researchers that there is great variability in their media skills and that their media practices change following media interactions. As a journalist, my goal was to actively support the public visibility of science. Once I moved to the academic setting and gained knowledge about theories and concepts such as mediatization, I started to recognize and critically evaluate my previous mindset and used these insights to guide the design of the PhD project. The selection of ESTCube-1 as the central case for this thesis was also not only due to its elucidative nature on mediatization processes but also because I had existing knowledge of their media practices and ready access to the research group.

Through reporting on ESTCube in the media and giving media advice and training to the team members, I have contributed to the mediatization processes I describe and study in this thesis. I acknowledge this fact in my analysis. At the same time, I have made efforts to separate my roles as researcher and a journalist/media trainer: once I had designed the study involving the researchers, I had no further interactions or engagements with them as a journalist.

The thesis is guided by three main research questions:

1) What elements facilitated the mediatization *process* of the investigated researchers?
2) What *indicators* can be used to describe the mediatization characteristics of individual scientists?
3) What *impacts* can be associated with the individual and collective media-related adaptions?

The introductory cover article of my thesis is structured as follows: In the first sections, the thesis introduces the theoretical background – the theory of mediatization and previous studies on mediatization of science; followed by an overview discussing

scientists in the media and the Estonian context. Section 2 will introduce the method and also discusses my position as a researcher, considering the effects of my personal involvement with ESTCube-1. In the empirical sections I will use the data gathered by interviews and media analysis to outline the results regarding the process, impact and indicators of mediatization. A discussion will place the results within the context of current trends in science communication and evaluate the contribution of the thesis to the mediatization framework. The concluding section will summarize the answers to the research questions.

The empirical section of this analytical overview largely re-uses the data published in the articles, with minor additions. However, in comparison with the articles, the analytical overview has a significantly expanded theoretical section which enables additional perspectives on the data and has contributed to new insights in the discussion. Therefore, I decided to incorporate the data into the analytical overview, considering that it also supports the reading of the thesis as a coherent narrative.

1. THEORETICAL BACKGROUND

This section will lay out the theoretical foundations of the thesis, first by exploring mediatization, the key concept of this thesis, and then by looking at how the interaction between scientists and journalists has been discussed in previous science communication literature. The concluding sections will provide a short overview of science communication in Estonia and the ESTCube-1 project.

1.1 THE CONCEPT OF MEDIATIZATION AND MEDIATIZATION OF SCIENCE

Mediatization has been described as "an ambitious umbrella concept" (Ampuja et al., 2014, p. 112). As a relatively new approach it has caused considerable discussion among scholars about the nature and value of this concept and its connection to other social theories. This section will introduce the various traditions of mediatization research and will discuss its application on the study of scientific institutions and individual scientists.

1.1.1 History and background

Throughout the 20th century, as mass media systems have expanded, we have become increasingly aware of the media's role as part of our everyday lives and as an important actor in society. Several earlier discussions about media in the fields of psychology, sociology, philosophy and other disciplines have paved the road leading to media studies as a separate field of research and formulation of the mediatization concept as a part of that field. Important early contributions, as highlighted by Andreas Hepp, were made by the Frankfurt School who pointed to the „omnipresence of media communication", the radical constructivists who see media as an autonomous social system „forming a model of reality accessible to all", and, finally, Marshall McLuhan, whose medium theory shifted focus on the „nature and capacities of each medium itself" (Hepp, 2013a).

By themselves, however, these approaches failed to describe all the complexities of the interactions between media and society, as did the established strands in the field of media studies, especially with the arrival of the internet, mobile phones and social media. Hence, „[t]he omnipresent and multidirectional nature of media's contribution to the "texture" of our lives /.../ came to require new approaches that moved away from the staid triangle of production–text–audience" (Couldry & Hepp, 2013, p. 193). Roger Silverstone and Jesus Martín-Barbero were some of the first scholars to discuss how media shapes or is shaped by life and culture more broadly. Silverstone used the term 'mediation' to describe the process in which we „engage continuously and infinitely with media meanings" (Silverstone, 1999, p. 17), meaning that it provided a perspective upon media communication „which is capable of reflecting its actual integration with social and cultural contexts or processes" (Hepp, 2013a,

p. 37). „The concept of mediation involves a more complex approach to reciprocal interrelationships saturated with power and which become concrete in the process of media communication," Hepp continues (2013a, p. 37). Similarly, Martín-Barbero used the term 'mediation' to „emphasize that (media) communication is a meeting point of quite diverse forces of conflict and integration" (Hepp, 2013b, p. 616).

Another important concept helping to lay the foundation for mediatization was 'media logic' proposed in the 1979 book of the same name by David Altheide and Robert Snow. Defined most broadly as the form and formats of communication, media logic „reflexively shapes interaction process, routines, and institutional orders; everyday life and institutional orders reflect and reify a communication order operating with media logic" (Altheide, 2013, p. 224).

As Couldry and Hepp note (2013), these multiple influences and research streams converged around a need to find a common term to describe research on media's broader influences. This term became 'mediatization' ('Mediatisierung'), mostly used by German and Scandinavian scholars of communication (sometimes spelled as *medialization/Medialisierung* by German researchers when discussing the role of mass media in particular).

1.1.2 Conceptualizations of mediatization

Although the term has now established itself, the field is populated by several approaches with somewhat different conceptualizations of mediatization. These agree that the aim of mediatization research is "to analyze critically the interrelation between changes in media and communications on the one hand, and changes in culture and society on the other" (Couldry & Hepp, 2013, p. 197) and mostly deals with the nature and possible effects of the dependence (Hjarvard, 2013) of culture and society on media. The approaches mostly differ in their scope and understanding of media.

The two main traditions[3] in mediatization research are broadly labeled as 'institutionalist' and 'social-constructivist' (Couldry & Hepp, 2013). The second tradition takes a wider cultural view and investigates the 'moulding forces' (Hepp, 2013a) of the media, i.e., various tools of communication. They see media logic as less relevant in comparison to people's practices when using various kinds of media technologies, seeking instead to study how the "diverse types of media communication are established in varying contextual fields and the degree to which these fields are saturated with such types", and consequently "the kinds of changes in communication that occur and hence the way in which reality is constructed" (Hepp, 2013a, p. 68). Mediatization is understood as a societal meta-process, similar to individualization or globalization (Krotz & Hepp, 2011).

[3] Lundby (2014) also adds a third one, a materialist approach, characterized by a focus on the material properties of the media in processes of mediatization.

The frame in which to investigate mediatization would be, in this perspective, 'mediatized worlds', defined by Hepp (2013b) as 'small life-worlds' or 'social worlds', "which in their present form rely constitutionally on an articulation through media communication" (p. 621). Inspired by Norbert Elias, he speaks of communicative figurations "as patterns of processes of communicative interweaving that exist across various media and have a 'thematic framing' that orients communicative action" (Hepp, 2013b, p. 623). Each communicative figuration is based on a constellation of actors, a thematic framing, their forms of communication, and, finally, a specifically marked media ensemble. According to Hepp (2013b) "these four instances help to describe how the institutionalization and reification of a certain kind of media unfolds an influence on the communicative construction of a mediatized world" (p. 624). To study the change, for example, in families, we would have to identify "the communicative figuration of the mediatized worlds" (Hepp, 2013b, p. 624) of families at different moments in time and analyze what has happened to these over time.

This tradition has been further developed to 'deep mediatization', a suggested new stage of mediatization that is driven by "digitalization and a related datafication" (Hepp & Hasebrink, 2018, p. 16) of communication tools. According to this perspective, our lives are increasingly shaped by the fact that "all media are tending to be based on software, which means algorithms become part of our media-related sense-making" (Hepp & Hasebrink, 2018, p. 16).

In contrast to the wide understanding of 'media' in the social-constructivist approach, the institutionalist tradition tends to focus on mass media and seeks to analyze how it "influences the social forms of interaction and communication" and also "the nature and function of social relations" (Hjarvard, 2013, p. 17). It covers levels from the individual – how media affordances structure human interaction of individuals within and between institutions – to the societal, i.e., its impact on society at large, but focusing its attention most on the meso-level – how "institutions relate to each other due to the intervention of the media" (Hjarvard, 2013, p. 37). Mass media is considered in this tradition a (semi-) autonomous social institution whose logic intervenes and influences the activity and logics of other institutions, such as politics, religion or science, while also providing a shared forum for communication that other institutions and actors increasingly use as an arena for their interactions. While Hjarvard sees that the concept of media logic can be expanded beyond the context in which Altheide and Snow created it – i.e., mass media – most authors using the institutional approach fix their focus specifically on interactions of other institutions with mass media and its logic(s).

The different understandings of media in the two approaches also guide their focus on different types of changes. Winfried Schulz has distinguished four processes of change to describe different aspects of mediatization: "First, the media extend the natural limits of human communication capacities; second, the media substitute social activities and social institutions; third, media amalgamate with various non-

media activities in social life; and fourth, the actors and organizations of all sectors of society accommodate to the media logic" (Schulz, 2004, p. 98). It can be said that the social-constructivist approach is most interested in the changes related to the first three processes whereas the institutionalist approach tends to look for instances of accommodation. Hjarvard describes substitution-like processes as a direct form of mediatization and more subtle processes, when an activity in its "form, content, organization or context" is influenced by media symbols, as indirect mediatization (Hjarvard, 2013, p. 20).

From the institutionalist perspective, accommodation of institutions to media logic is driven by the increased importance of media as the main platform to manage societal interactions, both as a source of information and a channel of communication. As these resources are controlled by media, other institutions need to adapt to the rules of media ('media logic') "in order to gain access to these resources" (Hjarvard, 2013, p. 23), leading to institutional transformations.

Jesper Strömbäck (2008) has described the process using the example of politics, proposing four phases of mediatization:

- In the first phase of mediatization, mass media constitutes the most important source of information and channel of communication between the citizenry and political institutions and actors, such as political parties, governmental agencies, or political interest groups.
- In the second phase, media (that in its early days was often born as a political instrument) has become more independent of political bodies and has begun to be governed by media logic, rather than according to any political logic. As more organizations become more autonomous, the influence of media at the institutional level increases; thus, media logic becomes more important to those attempting to influence media and its content.
- In the third phase, media becomes so independent and important that political and other social actors have to adapt to media. The formats, content, grammar, and rhythm of media have become so pervasive that no social actors requiring interaction with the public or influence on public opinion can afford not to adapt to the media logic.
- The fourth phase of mediatization is reached when political and other social actors not only adapt to the media logic and the predominant news values, but also internalize these and, more or less consciously, allow the media logic and the standards of newsworthiness to become a built-in part of the governing processes.(Strömbäck, 2008)

This approach to mediatization assumes that the strengthening of media's position will lead to the weakening of the institution that is accommodating media logic. Hjarvard uses the field theory of Bourdieu to illustrate the mechanism. According to Bourdieu, each field has an autonomous and a heteronomous pole where "the former

is the site of the field's immanent logic, where actors act with the field's own values" and the other "is the site of other fields' influence" (Hjarvard, 2013, p. 40). When media increase their role in the field's (or institution's) heteronomous pole, they also start to challenge the autonomous pole, Hjarvard argues, "[t]hus, the degree of mediatization may be measured according to how much the respective field's autonomous pole has weakened" (Hjarvard, 2013, p. 40). In the case of science, for example, this may mean replacing the scientific criteria of novelty, relevance and robustness by the media's criteria of news values, or associating scientists' reputations within the scientific community not with generation of new knowledge but with public interest and media prominence (Weingart, 2012) all of which weaken science's capability to produce robust new knowledge.

Kunelius and Reunanen (2016), however, ask how the argument of the strengthening of media's position relates to the similarly widespread narrative of a 'crisis of journalism'. Adopting a system theory perspective, they also suggest a new stage in mediatization where "control over the specific power resource of mass media and journalism – the management of public attention – has become more openly competitive" (Kunelius & Reunanen, 2016, p. 376). This leads to journalism struggling because the "institutional setting in which public attention is controlled and focused has changed into a more fragmented one" (p. 380).

Marcinkowski & Steiner (2009), on the other hand, contest the view that accommodation to media logic will necessarily lead to negative consequences for other institutions, i.e., that mediatization is a zero-sum game. They see that, despite the risk of side-effects, the process can lead to mutually beneficial relationships and is often initiated by the institutions themselves (pull), not forced upon them by media (push), due to "the contingent need for public attention of a given system combined with its inability to attract attention by system-specific means" (Marcinkowski, 2014, p. 11). Sawchuk (2013) describes the process of mediatization as a form of searching "for agency within [the] systemic forces and pressures" (p. 59) that includes conscious deliberations about "how these push and pull factors are experienced and negotiated" (Sawchuk, 2013, p. 54). She labels this form *tactical* mediatization, defining it as a deliberate and considered response aiming to retain one's own agency (Hjarvard & Petersen, 2013).

The more inclusive a social institution is, that is, the more its individuals and organization participate in communication activities, the more receptive it is to mediatization processes, Marcinkowski and Steiner (2009) argue.

1.1.2.1 *Criticisms of the concept*

Several authors have been critical about the lack of coherence of the concept of mediatization and its scarce analytical capacity. Deacon and Stanyer, for example, have criticized the loose definitions and the use of 'mediatization' as a convenient buzzword, calling it a "conceptual bandwagon" (Deacon & Stanyer, 2014). The term

has, indeed, been widely used (and misused) in many areas of media research. As described before and analyzed in several papers (Adolf, 2011; Ampuja et al., 2014), the field still lacks a unified framework and is often characterized by confusing use of terms.

This also concerns 'media logic', one of the key terms of mediatization framework, at least from the institutional perspective. As critics point out, 'media logic' is problematic because it presumes the existence of a universal or dominant set of rules that guides all media activities and their interactions with other social institutions. Besides problems with operationalizing media logic (that is, what these written and unwritten rules and norms are), one cannot ignore that each media channel and publication can have their specific set of rules, and that the rules evolve over time. Therefore, instead of a 'media logic' we would rather need to talk about 'logics' (Couldry, 2008), also meaning that when we understand mediatization as adaptations to media logic, a variety of logics lead to diverse forms of mediatization.

Mediatization is also said to be 'media-centric' and presuming linear media effects (Couldry, 2008; Deacon & Stanyer, 2014), neglecting the complex nature of our social world and various other influencing processes (Ampuja et al., 2014). Media itself is increasingly influenced by many other institutional logics, especially advertising, PR and marketing (Väliverronen, 2021). In their response, the main theorists of mediatization argue that media "are not necessarily the 'driving forces' of transformations. There are other processes of change that might find their expression in media and communications" (Hepp et al., 2015, p. 7). Rather than media effects, they add, mediatization seeks to understand the interrelation between the change of media and communication and the change of culture and society, admitting the multidimensional nature of the process of transformation.

Eskjaer (2018, p. 94) responds to similar critique by postulating that:

> *"media logic never determines the operations of other social systems; it only triggers reaction. And these reactions are self-regulated, leading to both self-preservation and self-transformation. This self-transformation (e.g., media training, hiring a web-editor, shifting to a new mobile platform, changing communication strategies) results in new structural interactions with the surroundings."*

Part of the critical reaction is produced by the theory's ambition to position itself as a new grand theory or meta-theory of media research (Ekström et al., 2016). As a result, most effort has been dedicated to developing macro-level theoretical frameworks and much less to providing them with sufficient support of methodological approaches that would enable mediatization to be operationalized on various levels and in many contexts. The field is in need of "a coherent, robust, and operational conceptual framework for a durable research program" (Jensen, 2013, p. 218) to produce empirical support for the theoretical claims and help to uncover plausible mechanisms for media-related transformations on all levels. In part, the lack of such

a framework is due to the immaturity of the concept and the work towards "more precise theories and analytical frameworks . . . to develop its explanatory potentials" (Ekström et al., 2016, p. 1097) is ongoing.

This thesis hopes to contribute to this aim by studying micro-level mediatization, i.e., the processes of change in the relationships of scientists with journalistic mass media, and by offering tools to evaluate mediatization on that level.

1.1.3 Micro-level mediatization

The focus of mediatization theory and research, as just described, has been mostly on transformations on the societal and institutional level. The institutionalist perspective, for example, has sought to analyze the progression of institutional actors to the phase where their actions are governed by media logic, not their own institutional logic (Strömbäck, 2008). Although acknowledging that individuals can contribute to the process and change environments towards or against mediatization (Lundby, 2014), there has been little conceptualization of how micro-level processes on the individual and organizational level contribute to transformation on higher levels.

An important model towards this aim is the idea of 'mental mediatization', proposed by Marcinkowski (2014). This model bypasses the criticism towards media logic by postulating that the core component of mediatization is not media logic *per se*, but what individuals perceive this logic to be. As individuals (politicians, in his example) experience "the omnipresence of media" and "what powers of influence the media can exercise . . . coupled with frequent contact with journalists, the persuasions of media advisers and their own extensive media consumption" (Marcinkowski, 2014, pp. 17–18) they develop ideas about how media functions. The perceptions then lead to adaptations that respond to this media logic, usually with the aim of gaining better access to media and the resources associated with higher visibility (e.g., more votes in the case of political actors). Therefore, Marcinkowski sees mediatization in terms of media effects but not effects in the conventional sense, triggered by media content, but changes in media-related attitudes and practices triggered by the anticipation of media effects on the audience.

This approach provides us with a clearer object of analysis: individual perceptions about media logic and the media's role, and related changes in practice that can be considered individual or organizational adaptations to the perceived media logic.

In a similar line, Kunelius suggests considering mediatization as a concept that helps to understand what is happening inside and between institutional boundaries. "At this level, the object of analysis of mediatization is not this or that "domain" of "institution" but rather, the transforming *patterns and practices of mutual interaction*" (Kunelius, 2014, p. 66); original emphasis). He recommends studying the changing pattern of relationships between social actors and the role of media in this (Kunelius, 2014). Hence, when we talk about mediatization of a social institution

(e.g., science), we mean the emergence of new patterns and interactions between this institution and others (that can include media itself) with media or media logic playing a defining role in shaping these interactions. While Kunelius does not specify the level of analysis, it is easy to see how the analysis of interactions can be applied on the individual, organizational and institutional levels – and how the changing pattern of interaction on one level can lead to a new pattern on the next one. The mental mediatization model supports this approach by suggesting the mechanism that shapes the individual actors' interactions with media.

A few studies have explored the link between the individual and organizational level processes of mediatization. Pallas, Fredriksson, and Wedlin (2016) describe how individuals' media logic gets translated and embedded into a governmental organization, and Scheu *et al*. (2014) do the same in the context of research organizations. The latter paper defines three structural levels on which changes take place: structures of interpretations, structures of expectations, and constellations of actors (Scheu et al., 2014, p. 712). These levels correspond, roughly, to the mental level (including perception of media's role, objectives and motives of the actors), adaptations of media-related practices and norms (on the individual and organizational level), and the resulting pattern of interaction between actors.

Scheu proceeded to define (2019) different types of mediatization on the individual level. Based on the perceived extent of mediatization (i.e., fewer or more adaptations) and the strategy of mediatization (whether seeking to increase media attention or avoid it and manage related risks), he defined five ideal types: opposing mediatization, working towards mediatization, defensive mediatization, balanced mediatization and offensive mediatization (Scheu, 2019). The study involved decision-makers in research organizations and concluded that the individual actors who favor offensive strategies of mediatization also report more extensive structural adaptations within their organizations (Scheu, 2019).

A way to analyze the interaction pattern empirically was proposed by Schweitzer (2012). She defined six empirical indicators to analyze how political parties present themselves during election campaigns on their websites. The indicators evaluate, among other properties of communication, the use of journalistic news style, focus on personalities of the candidates, and the use of messages of conflict and criticism (Schweitzer, 2012). The study presents a situation that, on the one hand, reflects an interaction pattern created by adoption of media logic and, on the other hand, creates the potential for new mediatized interaction patterns with other actors (e.g., with voters). Studying such situations and applying an evaluation scheme to identify the prevalence of individual and organizational interaction patterns may contribute to understanding which of these patterns are prevalent enough to be considered property of the social institution, hence, representing the mediatization processes on the institutional level.This thesis draws inspiration from all the mentioned approaches to micro-level mediatization and attempts to adjust and apply them to science. The next

section will discuss the current literature on mediatization of science and analyze it based on the distinction between individual, organizational and institutional levels.

1.1.4 Mediatization of science

Mediatization studies have paid most attention to capturing and analyzing media-related processes taking place in politics. Arguably, this is the social institution wherein mediatization is most pronounced both due to historically close links between media and politics (Strömbäck & Esser, 2014) and the inherent receptiveness of politics to mediatization because of the role of public communication in its functioning (Marcinkowski & Steiner, 2009).

Science has been considered more resistant to extensive mediatization (Rödder & Schäfer, 2010), mostly due to its 'logic' being less compatible with media logic. Differences in core epistemological beliefs and the norms of communicating these are a common source of tensions between science and media (Franzen et al., 2012; Kunelius, 2014).

However, as "the demand to communicate with the public has become part of [scientists'] legitimating exercises" (Weingart, 2012, p. 24) the relationship between science and media – and the accompanying potential for mediatization processes – has already grown more intense and directed science to seek ways to resolve or alleviate the tensions.

Weingart (2012) has laid out potential types of changes in science that can occur in response to science's intense media orientation. He proposes four levels with decreasing depth of adaptations (Weingart, 2012, pp. 27–28):
- Changes at the *system level*, such as replacing the scientific criteria of novelty, relevance and robustness by media's criteria of news values would effectively eliminate the special functional properties that make science an autonomous social institution.

- In the case of changes at the *program level,* media can amplify or guide the choices of researchers about what and how to study. Media discourse might support the preference for a certain theory or method, or give prominence to a certain field of science or topic that will then affect the proportion of attention it receives from the scientific community.

- Weingart notes that "scientists do not 'normally' communicate with journalists" (Weingart, 2012, p. 27). Changes on the *level of interaction* represent shifts in the constellation of actors with whom scientists are regularly communicating but also possible effects of this, such as changes in the mechanism of allocation of reputation. Science's orientation to media can create the potential for media prominence to be transformable into scientific reputation.

- Changes on the l*evel of organization* do not directly affect the research process but represent adaptations within scientific organizations to deal with the expectation to

communicate with the public. This includes, for example, arranging PR offices at universities.

This framework of changes can be useful for studying mediatization on any level, from individual to institutional. On each of these levels we can ask the questions that correspond to the types of changes described by Weingart: How is new knowledge evaluated? What determines the ways of gaining or organizing that knowledge? To whom is this knowledge regularly communicated? How are those interactions arranged? We can speak of mediatization once we can show that media or media-related considerations become a factor that shapes how individual scientists, research organizations or science as an institution answers these questions.

Empirical studies that have been looking at mediatization of science are mostly presenting evidence for mediatization processes taking place on the individual or organizational level, and are proposing indicators that reflect changes in interaction patterns (including media coverage of science) or organizational arrangement. Based on a distinction originally proposed by Weingart, two main trends of empirical evaluation of mediatization are described by Rödder and Schäfer (2010). The first links mediatization to the public visibility efforts of research organizations or individual scientists, i.e., the increasing orientation of science towards the media. The second investigates how the representation of science in the media has changed.

Examples of empirical indicators to describe mediatization linked to visibility efforts are suggested by Peters *et al*. (2009): the expressed importance of mediated communication of science by both individual researchers and organizations; the institutionalization of media interactions; and the adaptation of self-presentation to media logic.

A prominent manifestation of mediatization in this setting is the creation and expansion of PR offices at research organizations which, in turn, are part of the wider spread of the promotion culture (Väliverronen, 2021) and closely tied to the strategic aims of the organizations and the perceived role of public visibility in achieving these (Kohring et al., 2013; Scheu et al., 2014). This process has influenced the public presentation of science, on the one hand, via a stream of press releases that often get published in newspapers without editorial control or journalistic input (Autzen, 2014; Granado, 2011; Vogler & Schäfer, 2020). On the other hand, Peters *et al*. argue (2009), it leads to the adaptation of self-presentation to media logic. Such adaptation is guided by two considerations: expectation of increased publicity (Tsfati et al., 2011); and the needs and objectives related to legitimization, political influence and public profile (Peters et al., 2009). Not only does a university's public communication (press releases, facilitation of scientists to media) adhere to media logic but, in that process, also provides their researchers with informal feedback (and, therefore, an implicit expectation) about which topics, frames etc. are preferred by the organization as a means of increasing the public profile of the organization (Peters et al., 2009).

These developments, Peters *et al*. (2009) argue, are driven by the mediatization of politics. Mediatization becomes a prerequisite for societal legitimization processes of science and the impactful use of scientific expertise in political debates since these both require interactions via media and with other, already mediatized societal actors. As a consequence, mediatization is present or more intense in fields of science that need more public engagement with societal actors about their work. Examples include stem cell science (Peters et al., 2009), genetics during the period of the first human genome sequencing (Rödder, 2009a) or climate science (Ivanova et al., 2013).

Rödder (2009a, p. 454), summarizing Weingart's arguments, lists the following indicators for mediatization processes in science: organizing media events such as press conferences; the publication of research results in the mass media prior to their scientific publication; the occurrence of visible scientists; and the intertwining of scientific, political and media discourses. Additionally, characteristics of language such as adopting a catastrophe discourse or using promotional metaphors can be considered possible indicators for mediatization (Nelkin, 1994; Weingart et al., 2000). To compare the strength of mediatization, Lo and Peters (2015) have evaluated orientation toward media by measuring agreement with statements such as "scientists should communicate their results and expertise in an entertaining manner" or "journalists should only report on research results that have already appeared in scientific publications".

Besides adaptions undertaken by scientists and scientific institutions, these indicators also reflect changes in media representation in science – the second main avenue for empirical analysis of mediatization. Next to a notable increase in media coverage of science seen in many countries (Schäfer, 2011), Schäfer (2009) has proposed three dimensions in which mediatization can be evaluated:

1. Extensiveness: Science is increasingly present in the mass media.

2. Pluralization: Media coverage on science is increasingly plural in terms of actors and content.

3. Controversy: Media coverage on science is increasingly controversial. (Schäfer, 2009, p. 478)

Schäfer concludes that different fields of science display varying extent of mediatization and that highly "extensive, plural, and controversial coverage is usually concentrated in a rather short period of time" (Schäfer, 2009, p. 497). Rödder and Schäfer (2010) equate such periods of extensive mediatization with 'crisis' situations as defined by Bucchi (1996) where 'normal' patterns of interaction (and normal procedures for evaluating scientific claims) no longer work. During these phases, science loses its agenda-building authority that characterizes the routine interaction between science and the media (Rödder & Schäfer, 2010) and science becomes contextualized according to the criteria of the media (Rödder, 2009a).

The presented literature overview demonstrates that the analytical differentiation between media attention and media orientation as two aspects of mediatization of science (Rödder, 2009a) will lead to different conclusions about indicators for the evaluation of mediatization. Also, these give us a different picture of how widespread the phenomenon is in science. On the one hand, studies made among the scientific community (such as Peters et al., 2009) show that media orientation to science is perceived to be a common process on the organizational level but also present on the individual level – scientists consider visibility in the media important and responding to journalists a professional duty (Peters, 2013). While they generally attest to keeping the public and scientific arenas separate (Peters, 2013), they also express beliefs that some of the behavior of their peers could be primarily motivated by publicity considerations (Peters et al., 2009). On the other hand, when mediatization is seen being triggered by intense media attention to science (e.g., Rödder & Schäfer, 2010), the tendency is to conclude that extensive mediatization is limited to exceptional or 'crisis' situations within specific fields of science and does not extend to science as an institution. In both cases, the evidence indicates effects on public self-representation of science and scientists rather than on the core mechanisms of knowledge production (Peters et al., 2008; Väliverronen, 2021).

The different conclusions about indicators and extent of mediatization of the presented approaches can be explained with a focus on different specific aspects of the science-media interaction. Not all, however, that we know about the interaction patterns between scientists and media has been analyzed from the perspective of mediatization theory. The next sub-section will provide a brief overview of the aspects of the science-media relationship that might be relevant to understand and analyze mediatization processes in science.

1.2 SCIENTISTS AND THE MEDIA

„Visible scientists or public scientists have been present in every generation since modern science emerged in the seventeenth century", writes Bucchi and Trench (2014, p. 7). Similarly, "science stories have appeared in the mass media for as long as these channels have existed" (Dunwoody, 2021, para. 4). We have witnessed, however, significant changes in who, why and how presents science in the media. The discourse of 'popularization' where scientists act mainly as "informers and explainers" (Bucchi & Trench, 2014, p. 7) and the media as a passive mediator, is now complemented with a growing awareness of the variety of motives, power dynamics and practices that characterize science-media interactions.

Broks (2006), among others, have described the processes of specialization and professionalization that took place among both the scientists and journalists in the 19th and 20th century. Scientists, Broks notes, became victims of their own success in setting science apart as a professional activity: "The distancing that is needed to

maintain their authority is the very thing which undermines their legitimacy in the eyes of the public" (Broks, 2006, p. 143).

The distancing included conceptualizing what is acceptable public communication. Goodell (1977, pp. 91-93) has exemplified this by indicating the existence of a set of unwritten rules for communication. These include limiting communication to the researcher's area of expertise, avoiding controversies and political statements, devoting little time for it and doing it mostly in the later years of the researcher's career. Rödder (2012, p. 168) adds that researchers perceive media visibility of their peers to be legitimate if they present "sound scientific work", fulfill an institutional role or react to "being asked by the media". While among the scientific community "a dedicated scientist's public activities can be very acceptable – if he follows the rules" (Goodell, 1977, p. 93), such rules and conflicting expectations, Searle (2013) argues, have restrained scientists from being more effective and even made them appear to be poor communicators in the eyes of public and the media.

At the same time, attempts to reverse the distancing and address barriers to public communication are increasingly present on individual, organizational and institutional levels in science. Institutionally, the value of public communication and public engagement is now widely emphasized as means to legitimize science (Peters et al., 2009), combat misinformation (Iyengar & Massey, 2019) or democratize the scientific process (Chilvers & Kearnes, 2020; Dietz, 2013). Communication is framed as a duty of every researcher (e.g., Gregory & Miller, 2000; Rödder, 2012; The Public Understanding of Science, 1985) and as something that needs to be engrained in the wider scientific culture (Bucchi & Trench, 2014). For this, many authors argue, systemic barriers to communication, such as lack of resources, recognition and incentives need to be acknowledged and addressed (see, e.g., Gascoigne & Metcalfe, 1997; Rose et al., 2020; Searle, 2013).

Research organizations are committing more and more resources to communication (Entradas et al., 2020) and have become prominent, or even dominant (Marcinkowski & Kohring, 2014), actors in the field of science communication – not only in response to the policy shift described in the previous paragraph but also to address the (perceived) shortcomings of media in covering science (Allgaier et al., 2013; Samuel et al., 2017), to fulfill their own strategic goals (Marcinkowski & Kohring, 2014; Schäfer & Fähnrich, 2020; Scheu et al., 2014; Väliverronen, 2021) and respond to the pressures introduced by competitive funding system (Koivumäki & Wilkinson, 2020). The active role of organizations via their public relations activities is considered a vital part of the science communication ecosystem (Autzen, 2014), and as having the potential to promote dialogue, engage the public and increase trust (Borchelt, 2014; Roberson, 2020). While these have likely been some of the drivers in the increase of science content in media, the organizational turn in science communication is also problematized.

The core concern related to organizational PR is that it is "designed to promote and persuade" rather than "educate and inform", as Weingart and Joubert (2019, p. 7) argue. Coupled with the weakening position of (science) journalism and the trend that press releases are increasingly written in a journalistic style, disguised as journalism (Göpfert, 2010), we see an increase of science coverage in media that is based on press releases (see, e.g., Vogler & Schäfer, 2020). Studies of press releases have shown that, for promotional purposes, these tend to hide caveats of the studies and exaggerate claims (e.g., Ratcliff, 2021; Sumner et al., 2016). Therefore, dominance of the promotional discourse presents a risk of a distorted view of science that misleads the public, warns Göpfert (2010) or that "universities and scientific organisations . . . [are] being perceived as 'just another advertiser'" (Weingart & Joubert, 2019, p. 9), thereby threatening to decrease public trust in science in general.

In short, PR activities of research organizations are commonly perceived critically because "[m]ost communication experts within the scientific community work for organizations where the primary goals are about helping the organization, rather than advancing the overall scientific enterprise" (Besley, 2020, p. 158).

Not all empirical studies, however, confirm this. For example, Koivumäki (2021) points out that societally oriented strategic thinking appeared frequently and clearly among the views of communication professionals of research organizations.

The organizational trends have implications for individual level responses and practices, in different ways. On the one hand, the increased visibility effort of organizations also provides support for individual researchers' media interactions. Public relations offices distribute expertise about strategic communication such as considering objectives, goals and tactics (Besley, 2020; Roberson, 2020), work together with the researchers to contextualize research and manage routines (Koivumäki et al., 2021), and facilitate scientists to media (Marcinkowski et al., 2014). Institutions also increasingly see trainings as an effective way to support researchers' communication and engagement skills (Devonshire & Hathway, 2014; Newman, 2020; Trench & Miller, 2012). Marcinkowski *et al*. (2014, pp. 73–74) note that "[s]cientists who truly internalized the idea that a university should be visible in the media effectively show a higher frequency of media efforts".

The increased media orientation can also entail risks similar to those previously covered in the section 1.1.1.4 about mediatization of science. Marcinkowski and Kohring (2014, p. 1) warn that "[w]hat academics . . . say about themselves and their work (and what they do not) will depend crucially on the strategic communication goals and concepts of the organizations to which they belong." When (branding-related) interests of the research organization start to shape the ways in which a researcher represents science to the public, they might be considered "less legitimate as spokespeople for a field of expertise or the institution of science" (Horst, 2013, p. 775).

While the role of organizational identity may become more important for researchers in guiding their public communication, empirical studies investigating the

communication activities of researchers list a number other of motives that might align with organizational interests but can also be autonomous goals of the individual researcher or group of researchers. For example, next to the mode of representing the organization, Horst (2013), in her interviews with Danish scientists, distinguished two further identity-based roles that scientists take: representing a scientific field or discipline, and representing the institution of science (p. 763).

A further role-set for researchers as experts in public discourse is proposed by Väliverronen (2001). According to his typology, a *popularizer* presents new research results, an *interpreter* discusses new phenomena and problems, an *adviser/advocate* makes policy claims or comments on them, a *promoter/manager* seeks to legitimize science (e.g., by justifying the use of public funds), and a *critic* comments on research results (Väliverronen, 2001). Both Väliverronen and Horst emphasize that scientists usually combine different roles in an act of communication. Studies looking at individual-level motives of researchers to engage in public communication in general (e.g., Fiske & Dupree, 2014; Martín-Sempere et al., 2008; Peters et al., 2008; Rose et al., 2020) list motives such as legitimizing research, gaining trust and respect, increasing the public's interest in, understanding of and enthusiasm for science, and personal enjoyment in communication.

When it comes to understanding actual involvement with communication and the selection of specific objectives, it is valuable to analyze the attitudes as well as normative and efficacy beliefs of researchers, Besley and colleagues argue (Besley, Dudo, & Yuan, 2018; Besley, Dudo, Yuan, et al., 2018). For example, both external or response efficacy, i.e., the belief that their engagement activity can make an impact, and self-efficacy, i.e., the belief that one has the relevant communication skills, are shown to be consistent predictors of engagement (Besley, Dudo, Yuan, et al., 2018; Besley et al., 2013, 2019, 2020, 2021; Dudo & Besley, 2016; Poliakoff & Webb, 2007).

Kessler *et al.* (2022, p. 711) demonstrate that different mental models about science communication among researchers "largely align with the way they practice science communication". That is, the motivation for communication also guides and predicts the methods, target groups and channels. For example, the authors note that researchers in precarious working conditions or in strong competition with other academics tend to display the mental model of strategic science communication, in comparison with the Public Understanding and Public Engagement models.

The way scientists perceive the relationship of science and society is also seen by Rödder (2009b) as a crucial component shaping their media presence. Using tolerance of media-oriented communication as the second dimension, she created a typology of publicly visible scientists and describes four ideal types (Geek, Missionary, Advocate of Science, Public Scientist), each with a distinct understanding of their role in media communication. The typology, however, is less specific on the resulting practices and considers scientists as operating within a mediatized environment, not as agents of mediatization themselves.

And then, there are the extreme cases (Rödder, 2009b, p. 185) of scientist celebrities. "[S]cientists who successfully communicate over a long period of time with broad audiences will inevitably become celebrities," Fahy and Lewenstein note (2021, para. 38). On the one hand, this process is driven by the media feedback loop, as media tends to prefer sources who are already familiar to them and the audience (Peters, 2014). They become focal points for journalists, audiences, and scientists seeking to make sense of science (Davies & Horst, 2016). On the other hand, the individual characteristics of the scientists align well with media expectations - they tend to be articulate, controversial, have a credible reputation, a colorful image and work on hot topics (Goodell, 1977).

Also, such scientists often actively cultivate a public presence (Fahy & Lewenstein, 2021) and craft a public image that conformed to these characteristics "in order to make themselves more likely to be selected and given prominence by media figures" Fahy (2017, p. 1020). Goodell (1977) observed that participation in public communication among the highly visible scientists is encouraged by certain moral, political, and social concerns. They use their public image to promote a certain agenda, become "issue advocates" (Pielke, 2004), and, in some cases, "to argue for scientific theories which they were struggling to have accepted by the scientific community" (Fahy & Lewenstein, 2021, para. 18).

In summary, we see that the nature of media engagement of researchers is an interplay of institutional, organizational and individual level factors, all of which include both restraints and rewards (Searle, 2013). On each of these levels, the answers to what level and kind of media presence are considered acceptable and necessary may differ and are subject to negotiation. This is also reflected in the ongoing discussion about how strategic communication in science extends beyond persuasion (Besley, 2020; Kessler et al., 2022; Roberson, 2020).

Similarly, the practices of (science) journalists are shaped by sometimes contradictory individual and institutional factors and they are subject to negotiations of professional boundaries as well. Often, science journalists are perceived to cover science in an uncritical and deferential manner (Hansen, 2009; Nelkin, 1995) due to their closeness with and dependence on the scientific community (Gregory & Miller, 2000, p. 107). This is more likely if the journalists view their 'professional mission' in terms of popularization, rather than public need for information and expression of public concerns (Bucchi, 2004).

The other view perceives the identity of science journalists to be rooted mainly in journalism (Hansen, 1994). "[T]hey strive to maintain the respect of their scientific sources and to satisfy the ideals of science, but they must, first and finally, meet the constraints of their own profession," argues Nelkin (1995, p. 100). Theoretical literature discussing the role of science journalists (see, e.g., Blöbaum, 2017) emphasizes the need for a critical view by journalists.

Each of these ways entails different practices of selecting and presenting scientists in the media and interacting with them. However, it seems that scientists are increasingly taking more agency in this process, both due to having more skills and resources themselves and due to more difficult working conditions in most of the world of journalism. Also, science journalism has been affected by staff cuts and increase in work load (Massarani et al., 2021) that make it more difficult to enact the critical role. Those recent technological, economic, and social changes, as Kunelius (2014, p. 78) has noted, have "made the boundaries of professional identities, institutions, and practices much more porous and difficult to manage than they used to be and journalists have lost control of some key aspects of their professional field".

While there have always been scientists who have been able to control the media agenda, for example, those portrayed by Goodell (1977), and journalists have been warned to be cautious about political motives of scientists (Allan, 2002), the issue has become more relevant as more researchers and research institutions adopt the model of strategic communication for their media interactions. Scientists are familiarized with elements of media logic in science communication trainings (Besley et al., 2015) and communication specialists support the strategic planning and implementation of (media) communication activities (Koivumäki, 2021). This is expected to result in media visibility in a more controlled way. At best, this can help to increase the societal impact of science. Alternatively, these skills can be used to "make every effort to try and ensure that their preferred definition of the issue or event is placed in a positive light" (Allan, 2009, p. 158). The next section will present literature on the skills or competences necessary for scientists for effective public communication.

1.2.1 Science communication skills of scientists

One of the outcomes of science communication evolving into a field with specific societal aims and scientists being increasingly involved (or expected to be involved) in public communication activities, has been the emergence of ideas about what is effective science communication and what are the necessary skills that communicating scientists need. Next to numerous training courses, practical guides and handbooks for scientists, these ideas have also resulted in some academic frameworks that aim to define "core skills"(Mercer-Mapstone & Kuchel, 2017), "foundational skills" (Aurbach et al., 2019), "essential elements" (Bray et al., 2012), "quality indicators" (Olesk et al., 2021), or similar, all suggesting relevant skills-sets.

The approaches vary in their extent: some aim to cover all types of science communication, some focus on specific disciplines (e.g., Brownell et al., 2013) or formats of communication (e.g., Baram-Tsabari & Lewenstein, 2013). While we seem to encounter specific advice for media interactions more frequently in practical guides than in academic frameworks, the latter's broad approach contains many elements that are also applicable to communication via media.

Those relevant elements can be grouped, in general terms, into two main clusters: language and style, and audience considerations. The first is centered around the core skill of 'using a language understandable to the audience' (Mercer-Mapstone & Kuchel, 2017) to which various frameworks add a variety of skills that help to explain science in a clear and interesting way, from avoiding jargon to telling stories. The second emphasizes the need to "focus on the audience and how to access their needs, priorities and imagination" (Bray et al., 2012, p. 38). Here, relevant skills include identifying and understanding the audience(s) and tailoring the messages accordingly.

Studies looking at actual content of communication training, however, tend to show that most of the training provided at research institutions focusses on elements of the first cluster, with aims of "presenting results and explaining ideas" (Stevens et al., 2019, p. 1171) and "fostering a more informed public" (Dudo et al., 2021, p. 52). Audience-related goals, whether aiming for more engagement with the public or adopting a more strategic communication approach, are yet to strongly shape the training programs.

In media interactions, the audience considerations have traditionally been the responsibility of the mediator, i.e., the journalist. However, those skills have become more relevant for scientists as they are gaining more control over (media) communication as a result of some previously described tendencies, especially the increased influence of university communication, wide uptake of social media and the rise of strategic motives in science communication.

While it is not listed as a specific skill in the competence's frameworks, some authors have argued for "understanding of the mechanisms of the media" (Gascoigne & Metcalfe, 1997, p. 275) as a key element in gaining better control over media appearances. Workshops to break down "cultural barriers" and "a stereotypic image of journalists" (Metcalfe & Gascoigne, 2007, p. 99) have been found to improve the confidence of researchers in communicating with media (Metcalfe & Gascoigne, 2009). In essence, these workshops have provided scientists with knowledge of media logic and thereby contributed to the mediatization processes.

2. METHODOLOGY

Lack of a coherent ways of operationalizing mediatization has been a frequent critique of the concept (see, e.g., Deacon & Stanyer, 2014). The difficulties arise not only from the variety of approaches within mediatization framework, each of them with a different perspective on mediatization, but also from the frequent focus on macro-level, or meta-processes (Krotz & Hepp, 2011). Additional complications for empirical work include the fact that conceptualizing mediatization as a process necessarily requires longitudinal analysis to capture change, and to make sense of these changes, one requires "inside knowledge of the different social functional systems" (Meyen et al., 2014, p. 283). As a shortcut, many scholars tend to assume that various systems are already mediatized and jump to describing the situation (Strömbäck, 2008).

In response, the main mediatization theorists suggest that the common focus of different mediatization approaches is the changing pattern of interactions (Lundby, 2014) with media and communication technologies and institutions. This entails both quantitative and qualitative aspects that can be captured empirically on various levels. Deacon and Stanyer (2014) recommend that a more solid methodological basis for the mediatization framework would require developing additional concepts at lower levels of abstraction. To capture processes, one should, according to Lundby (2014, p. 23) "have several observations of moments and objects along the way that . . . indicate a transforming direction or tendency".

The methodological approach of this thesis is guided by the understanding offered by Marcinkowski (2014) that mediatization is a process rooted in the perceptions of individuals and the adaptions that are undertaken based on these perceptions. Building on this understanding and analyzing the interactions resulting from these adaptions will allow to develop a conceptual framework of micro-level mediatization that offers a way to evaluate mediatization empirically.

This aim led to the choice of semi-structured qualitative interviews which is a classic method used in social science and humanities to understand the "perspectives, perceptions, experiences, understandings, interpretations, and interactions" (Mason, 2004, p. 1021) of individuals. As a methodological tool, each individual interview provides a description "of the lived world of the interviewee . . . with respect to the interpretations of the meaning of the described phenomena" (Kvale, 2007, p. 30). At the same time, when each interview is understood as having systematic connections with the sociocultural circumstances and theoretical developments, they "embody and represent meaningful experience–structure links" (Crouch & McKenzie, 2006, p. 493), allowing new concepts to be generated and current concepts to be expanded. Together, the interviews tell a collective story, piecing together a theoretical narrative that has interpretive power (Charmaz & Belgrave, 2012). Thereby, the interviews allow the construction of a coherent image of mediatization processes based on individual perceptions and experiences.

In my thesis, I use the qualitative interview method in three articles to explore various aspects of mediatization of scientists (for discussion on strengths and limitations of various methodological approaches, see Section 2.2). The characterization of micro-level mediatization is based on interviews with three groups of Estonian researchers (altogether 22 people) who, based on their media visibility profile, can be considered to have been involved in mediatization-related processes. More specifically, I employed qualitative interviews to explore the perceptions the respondents had about media and its operating logic, the reflections about the value of media visibility, and of their own media behavior and relationship with journalists.

The interviewed groups – ESTCube-1 team members, decision-makers in science, and visible scientists – were selected for their ability to illuminate various aspects of mediatization (the selection criteria of the individuals in the sample are explained in more detail below in the section about sample selection). The ESTCube-1 team is a relevant case for all three aspects – process, indicators, and impact. It is suitable for investigating the process, since, for them, the mediatization process took place quickly and intensively, allowing the relevant factors to be identified. They also turned out to be a good group to develop the indicators of mediatization due to displaying an internal diversity in the intensity of mediatization under otherwise similar conditions. When reflecting on their communication experiences within the project, the team members often offered thoughts on how they would like to manage media interactions as part of their work in the future. These responses are considered when discussing the impact of mediatization.

Impact, in the form of organizational adaptions, and the motives for such changes were also explored in the interviews with science decision-makers. Additionally, this group provides clues on how the individual (micro) level and the organizational (meso) level are related in the mediatization processes, i.e., how the individual perceptions and practices guide adaption on the organizational level, contributing to the mediatization of the entire field. Finally, the group of visible scientists was used to confirm and validate findings that came from investigating the more specific groups. The visible scientists served the purpose of testing whether the understanding of the mediatization process and list of indicators that were derived from interviews with the members of ESTCube-1 also apply more generally.

The study follows the abductive approach throughout the analysis. It relies on previous personal experience as a journalist, analytical frameworks and theoretical insights from the studies on mediatization of politics and mediatization on the meso- and macro-levels while allowing empirical material to give "feedback to the original theorizations that motivated these codes in the first place" (Tavory & Timmermans, 2019, p. 541). This has helped to select the most appropriate framework and develop these existing theories further. Some themes (such as impact on science) are based by previous frameworks to a larger extent than others. The analysis becomes largely inductive when developing original contributions such as a description of the process and list of indicators by a systematic examination of similarities within the group.

In addition, Article III uses quantitative content analysis to look at the characteristics of ESTCube-1's media coverage. Media content analysis was conducted to evaluate how ESTCube-1 was presented in the media and relate the descriptions of media interactions reported by the involved researchers with actual outcomes.

2.1 PRINCIPLES FOR SAMPLE SELECTION AND DATA ANALYSIS OF INTERVIEW GROUPS

I describe the main characteristics and principles of qualitative interviews and their analysis in the following table.

Table 1. *Description of interviewed groups, interview structure and analysis tools.*

	Science decision-makers	**ESTCube-1 team**	**Visible scientists**
Sample size	*7*	*8*	*7*
Data gathering period	*January to February 2016*	*August 2014 to May 2015*	*April-May 2018*
Main sections of the interview	*Role of media for their work, perceptions of media logic, structural adaptations in response to media logic.*	*Media interactions during the project, perceptions of media logic, learning process, media relations' impact on the project.*	*Relevance and aims of media interactions, media interaction practices, perceptions of media logic, usage of media logic.*
Elements developed using inductive analysis		*Process of mediatization; indicators of mediatization.*	
Elements analyzedand main frameworks used	*Perceptions of media logic and structural adaptions, based on the framework by Scheu et al. (2014).*	*Impact of mediatization, based on the framework of Weingart (2012).*	*Indicators of mediatization, based on framework developed in the ESTCube-1 group.*

I conducted and analyzed the interviews with the three groups following similar procedures. All interviews took place face to face (except for one Skype interview in the ESTCube-1 group) and in Estonian (except for one interview in English in the ESTCube-1 group). Interviews consisted of open questions, structured according to the interview focus (see Table 1). The interviews lasted typically between 45 and 60 minutes, were recorded and transcribed.

Since all interviewees were selected on the premise that they have had potentially mediatization-inducing media interactions, a central strategy of the interviews was to have them reflect on those personal experiences. By discussing some examples that they perceived as positive and negative interactions with journalists, and by analyzing the potential factors that shaped those experiences, the interviews gave a deep understanding of how the interviewees think about media and themselves in relation to media. Following questions about motivation, media routines, adaptions and perceived impacts were linked both to those personal experiences and concepts presented in theoretical frameworks.

The transcripts were manually coded during an "interested, careful reading of the text" (Kuckartz, 2014, p. 71) and followed different strategies of qualitative text analysis for different research questions. To analyze the process and impact of mediatization, I used classical thematic analysis in which the categories are created and refined in a two-step process: initial or open coding develops main categories, and subsequent selective or focused coding helps to determine relevant sub-categories (Charmaz & Belgrave, 2012; Kuckartz, 2014). To understand the process of mediatization, I formed categories around elements that, according to the interviewees, guided, supported or motivated them to improve or intensify their media interactions. For impact of mediatization, the categories reflect permanent changes on individual or institutional level that are motivated by desire to gain more media visibility but go beyond mere adaptions to media practices. The levels of changes proposed by Weingart (2012) was the main framework that served as inspiration for the categories and analysis.

To define the indicators of mediatization I used evaluative text analysis with the aim to identify categories that allow assessing the content, rather than just systematizing it as is common in thematic research (Kuckartz, 2014, p. 88). The first step in the process of analysis was to identify categories where meaningful differences occur in the practices or attitudes of the interviewees. This step was followed by comparing individual responses to create a relational scale for each indicator (see example in Figure 2, p. 64). These helped to define two main levels that were the basis of the final step, describing and naming two ideal types.

In detail, the sample selection for each article was as follows:

Article I chose the field of science policy to investigate the media's role for the constellation of stakeholders and therefore selected the organizations considered most important in the field. First, I identified the most relevant organizations in Estonia, i.e., universities, non-academic research organizations, science-policy advisory boards, and science funding bodies, and approached the decision-makers within the identified organizations for an interview. All interviewees held a leading position (e.g., Director, Head, President/Vice-president) at their organization at the time of the interview. The list of represented Estonian organizations is the following:

Table 2. *Interviewed science decision-makers (interviews D1-D7)*

Interview no	Institution
1	Estonian Research Council
2	University of Tartu
3	Tallinn University
4	Estonian Academy of Arts
5	National Institute of Chemical Physics and Biophysics
6	Estonian Academy of Sciences
7	Estonian University of Life Sciences

For **Article II**, I requested interviews from team members who had leading positions in the ESTCube-1 project (e.g., manager of a sub-system) and presented the project in media. All interviewees were male, aged 24 to 42 at the time of the interview. All were PhD or MSc students at the time, except for the project supervisor who was an associate professor. The list is presented in Table 3.

Table 3. *Interviewed ESTCube-1 members (interviews E1-E8, source: Article II)*

Interview no	Role(s) in ESTCube-1	No. of media appearances during the project
1	Project supervisor	122
2	System architect, student supervisor	4
3	Project manager	20
4	Manager of communication subsystem	9
5	Manager of electrical subsystem, manager of attitude determination subsystem, systems engineer	8
6	Manager of battery subsystem, satellite integration, launch preparation	3
7	Manager of power subsystem, launch preparation	7
8	Manager of attitude determination and satellite control subsystem	3

For **Article IV**, I selected a number of Estonian scientists who can be considered publicly visible or have been recognized for their media communication activities. I included all researchers who have been awarded the Person of the Year recognition by the *Postimees* newspaper (awarded since 1997), and the two most recent recipients of the award Friend of Science Journalists, awarded by the Estonian Association of Science Journalists[4]. One researcher was selected based on public data released by

[4] Two more scientists (the supervisor of the ESTCube-1 team and the President of the Estonian Academy of Sciences) have also received both the Person of the Year recognition and the Friend of Science Journalists award. They were interviewed in the ESTCube-1 group and group of decision-makers, respectively.

his university, indicating that he was their most media-visible researcher. In addition, I selected representatives of two organizations that were prominently visible at the time: the recently-formed Estonian Young Academy of Sciences and the Estonian Biobank. The first effectively engaged its members in writing science-related opinion articles, and the latter was, at the time of the interview, conducting a national campaign to recruit 100,000 gene donors.

Table 4. *Interviewed visible scientists (interviews V1-V7)*

Interview no	**Research field**	**Position**	**Recognition / visible project**
1	Engineering	Professor	Friend of Science Journalists
2	Bird ecology	Researcher/communication specialist	Most productive author of the university
3	Genetics	Senior Researcher	Estonian Biobank
4	Molecular biology	Professor	Friend of Science Journalists
5	Ecology	Research Professor	Person of the Year
6	Genetics	Professor	Person of the Year, Estonian Biobank
7	Physics	Senior Researcher	Estonian Young Academy of Sciences

The gender balance across the total sample was 18:4 in favor of men. The ratio reflects the general underrepresentation of women in senior and decision-making positions in Estonian science, especially in the fields of natural science and engineering. For instance, as of 2022, the share of women among professors in Estonian universities is 35% and among members of scientific boards 32% (Estonian Research Council, 2022). The ESTCube-1 media data analysis conducted for this thesis showed that female team members featured in one press release (out of 30) and six media items (out of 160). The only sample source where the situation was more equal, approximately 50:50, was the science communication award Friend of Science Journalists.

In the thesis, quotes from the interviews are referred to by using a code consisting of a letter indicating the interview group (D – decision makers, E – ESTCube-1, V – visible scientists), followed by the number of the interviewee.

2.2 STRENGTS AND LIMITATIONS OF RESEARCH APPROACHES

Without the ambition to provide ’objective’ or general truths about the world, many of the frequently discussed limitations of semi-structured interviews become less relevant. When the aim is to be “intentionally conceptually generative” and

"indicate rather than conclude" (Crouch & McKenzie, 2006, p. 492), smaller and not fully representative samples can be justified if other criteria of validity are met (see P. Miller, 2008); and the inevitable subjectivity of both the researcher and the respondents becomes part of the generative effort, especially when the phenomenon under study – as is 'mental mediatization' in this thesis – manifests itself in individual perceptions.

The main limitations of interviews in the context of this thesis lies in their bounded capability of capturing mediatization processes. For these studies I use interviews both to investigate the mental concepts of respondents that underlie mediatization and the resulting practices and changes in practices and attitudes. While interviews are well-suited for illuminating the first aspect, one must be aware of potential biases in case of the latter aspects. As the conclusions about the practices and involved changes fully rely on accounts and reflections of the respondents, any intentional or unintentional omission or misrepresentation may affect the research interpretations. In the case of ESTCube-1, this can be overcome to a certain extent by collecting various accounts of the same process. With other respondents, I have used my 10-year experience in science journalism to critically reflect on the trustworthiness and credibility of the statements regarding their interactions with journalists.

Strictly speaking, the conclusions about the process of mediatization are made based on a single research interview with each respondent and their own perceptions of the process. This can also be considered a limitation of the research approach, as Lundby suggests to "have several observations . . . along the way" (2014, p. 23) to capture the occurring changes. Here, again, personal experience was used as an additional input. As I was familiar with the ESTCube-1 project and interacted with them (and with some other scientists from the other interview groups) regularly as a journalist, those observations along the way were collected, although not in the structured scientific way. The perspective gained when reflecting on those personal experiences as a journalist is integrated into the conclusions.

Some of these limitations could have been overcome with integrating an (auto) ethnographic component to the research. Being able to follow the actual media interactions of researchers or even better documenting my own interactions with them as a journalist would have provided richer data and helped to evaluate the interview statements. The reason not to use the ethnographic research method was purely practical. By the time of starting my PhD, the ESTCube project, which I had chosen as my core example, was already well underway, a few months away from the launch of the satellite. The proper preparation of an ethnographic study would have taken further time, making it possible only to conduct it after the most intense periods of media interactions. I also perceived that it would create a role conflict when I would have simultaneously interacted with the group as a researcher and a journalist. However, considering the valuable insights that ethnographic approach can give to understanding media practices and micro-level mediatization, I hope to see the method applied in future studies.

Likewise, the qualitative conclusions of this thesis can be further expanded and validated with quantitative studies. Within mediatization studies, the strength of the quantitative approach has been the potential to evaluate certain changes over time, whether in science content in media or in individual attitudes and practices related to media. However, according to Ekström et al. (2016, p. 1102), such studies "are not concerned with the sociocultural processes through which media themselves . . . become indispensable to various social actors". Some indications about those processes can be extracted from studies surveying the attitudes, motivation and experiences of scientists in relation to public communication (many studies led by Hans Peter Peters or John Besley are a good example). Still, I would argue that since we do not have a sufficiently decent understanding of micro-level mediatization, quantitative studies need to go hand-in-hand with qualitative research. The quantitative media content data presented in this thesis is a good example, as it provides little meaningful information without the qualitatively derived understanding of the media practices of scientists.

2.3 PRINCIPLES OF SAMPLE SELECTION AND DATA ANALYSIS OF MEDIA ANALYSIS

The thesis collected all press relevant media and public relations content about ESTCube-1. The media content analysis in **Article III** uses quantitative content analysis of press releases about ESTCube-1 (n=30) and journalistic media items from Estonian media (print and online articles from newspapers and magazines, TV and radio clips; n=160). The sample covers data from almost seven years: the first press release, announcing the project, was issued in July 2008 and the final media item was published in May 2015 when the satellite stopped working.

Press releases about ESTCube-1 were issued by the University of Tartu (n=29) and the Estonian Space Office (n=1), although most of them were prepared by ESTCube members themselves. The main principle in selecting media items was to include only original journalistic material, that is, items based on an interaction between a journalist and a project-related source or editorial content. Items without any journalistically added value, such as rewrites of press releases, Facebook posts or other media items were excluded from the sample.

To collect media items, I relied on the public media log by the ESTCube-1 team that functioned during the first few years of the project, and reached the Estonian libraries' article database ISE, and the archives of all national newspapers and main broadcasters for keywords "ESTCube" and "tudengisatelliit" ("student satellite").

The main feature in coding, besides basic characteristics such as article author, length and type of quoted sources, was the element described in Article III as 'angle'. The basic principle of angles is the same as 'attributes' in agenda-setting or 'aspects' in framing research, that is, to help to identify and characterize the "relative salience of numerous aspects of the topic" (McCombs & Reynolds, 2002, p. 12). As described

for agenda-setting: “Each of the objects on an agenda has numerous attributes . . . Just as objects vary in salience, so do their attributes. Both the selection of objects for attention and the selection of attributes for picturing those objects are powerful agenda-setting roles” (McCombs & Reynolds, 2002, p. 10).

Both agenda-setting and framing are about media effects on the audience: framing investigating the variety of textual characteristics that structure the reader’s understanding of the issue and agenda-setting comparing the salience of topics in media content and audience perceptions. The approach of this analysis is closer to agenda-setting, looking at the salience of various facets of the ESTCube-1 project – such as its scientific mission, the engineering challenges or the educational nature of the project – in press releases and media coverage. While this analysis differs from classical agenda-setting by not aiming to analyze the salience of these attributes in public perception, it considers the salience of attributes in media coverage as the effect of agenda-setting activities of the scientists. Hence, in this text I will adopt the term ‘attributes’ to refer to angles of the topic.

The attributes of ESTCube-1 are understood as distinct facets of the project that either represent different types of activities conducted within or in relation to the project, or the different contexts in which the project is placed in media coverage. The attributes were coded following the two-step process suggested by Charmaz and Belgrave (2012). First, I identified the attributes during the initial or open coding by analyzing the sentences and paragraphs in the text and determining the project activity or context of presentation. To be coded as an attribute, the activity or context needed to be elaborated in the text, not merely mentioned. Similar activities or contexts were then grouped to produce the list attributes described in Section 3.3.2. Finally, the list was used for selective or focused coding to determine up to three most salient attributes in each press release and media item.

I was the sole coder for all data. As the two-step process involved multiple reading of the texts to develop codes, no separate reliability evaluation of coding was performed.

2.4 CASE STUDY APPROACH

Although this study was not designed as a case study, a large part of the empirical material is related to a single project and a single country. Therefore, the questions of representativeness and generalizability that often accompany case studies are relevant here as well, especially given the theory-building aim of the thesis.

The longstanding debate over the capability of case studies to inform and develop social theories has brought forward arguments that the general applicability of case studies “results from the set of methodological qualities in the selected case, and the rigor with which the study, or the analysis resulting from this case, is conducted” (Hamel et al., 1993, p. 39). An in-depth study can be considered “a sort

of experimental prototype" and "will yield explanations of the properties inherent in social relationships" (Hamel et al., 1993, p. 37). Theory and hypotheses can be built on these results because:

> *Any explanation for events in one context necessarily treats them as an effect of a sort that is produced (under certain conditions) by some specific type of cause; so that it can always be found in other contexts - at least in principle* (Hammersley et al., 2009, p. 238)

Methodologically, Hammersley, Gomm & Foster (2009) recommend checking causal hypotheses by comparing across cases.

This study treats mediatization as a social process that is predominantly guided by the general structural properties and the operating logic of Western media and science systems. Hence, it can be assumed to lead to similar outcomes across different contexts, with local setting or individual cases producing interesting but not fundamental variations. Thus, the strengths of case studies support theory-building in the field of mediatization. This thesis additionally uses elements of comparison to further support conclusions, such as comparison with Germany (in Article I), within the ESTCube case (Article II) and with other researchers (Article IV). The analytical approach is also not merely inductive, as is characteristic to case studies, but abductive, that is, also including comparison with personal experience.

However, the context of the ESTCube project and of Estonia in general is still important to understand, therefore I will summarize them briefly in the next sections.

2.4.1 The context of Estonia

Despite its small population (1.3 million), Estonia has a well-developed science communication ecosystem and a long tradition of science media. While the gaining of national independence in 1918, the Soviet occupation in 1940 and the restoration of independence in 1991 were all followed by an almost complete transformation of all societal systems, including science and media, the position of scientists in the society has remained high.

The history of popular science media in Estonia goes back to 1766 when the first Estonian-language periodical publication, the magazine *Lühhike öppetus* (*Brief instruction*) was published. In the spirit of enlightenment, this magazine contained practical medical advice for the Estonian peasants (Kalling, 2002). Magazines were the most common media format for presenting science until the end of the 20th century. Notable examples include the first illustrated Estonian magazine *Mailm ja mõnda* (*The world and other things*, 1848, published by Friedrich Reinhold Kreutzwald), *Eesti Loodus* (*Estonian Nature*, 1933-1941, 1958-) and *Horisont* (*Horizon*, 1967-).

The latter two magazines mostly present articles written by scientists in accessible language and contributed to making some scientists household names in Estonia.

In the 1970s and 1980s, their top circulation numbers reached above 50,000 copies ("Horisont faktides," 2016), demonstrating the popularity of the topic among the population. To some extent, this has to do with a lower level of ideological control in these magazines. Both science and environment as societal topics, and these magazines as specialist publications, were subject to a lower level of political control, compared to the Communist Party newspapers and ideological, political and historical topics (Lauristin & Vihalemm, 1993). This difference is evident, for example, in the style and topics in science coverage of the 1960s Estonian media – whereas the articles in Horisont barely included any ideological content, the daily newspapers of the same era used science often to reinforce ideological meanings (Olesk, 2017). In the late 1980s, environmental topics were one of the triggers for the movement to restore national independence and many scientists rose to the forefront of the movement.

The turning point towards science communication in its modern form, including the diversification and professionalization of the field, can be dated to 2004-2005 (Olesk, 2020). Today, science content is present and well-visible in all major Estonian media channels, with television, newspapers and online channels being the most important mediums from which people get information about science (Ainsaar et al., 2020; European Commission. Directorate General for Communication, 2021). In contrast to the situation in many other developed countries (see, e.g., (Massarani et al., 2021), Estonia has experienced an increase in the number of science journalists in the last decade as many outlets have only then established their science reporting team. Regarding universities, meanwhile, there is a similar trend of expansion and professionalization of communication and PR activities, as seen in many other countries.

Trust towards scientists is one of the highest in the EU, although people concede not being very informed about science (Ainsaar et al., 2020; European Commission. Directorate General for Communication, 2021). In the last decade, Estonian science has been characterized by high quality (as evaluated by bibliometric indicators such as citations per paper, see Lauk & Allik, 2018) but also a chronic lack of funds, leading to a highly competitive research environment (Raudla et al., 2014).

At the same time, the aims and dominant practices of science communication in Estonia, as reflected in, for example, the national strategy for science communication (Estonian Research Council, 2019) or the motivation of universities (Oone, 2020), largely follow the Public Understanding of Science and science education frameworks, rather than public engagement (Olesk, 2020).

This short summary provides context for understanding the public reception of ESTCube-1. On the one hand, the project's visibility was supported by the long history of positive media coverage of science and a tradition of visible, popularizing scientists. On the other hand, the ESTCube team took advantage of the institutional premises for mediatization processes in science that were created only after Estonia's recent integration into the Western world.

2.4.2 ESTCube-1

ESTCube-1 was a satellite designed, built and operated as a student project. The idea of ESTCube was proposed by Mart Noorma, at that time an associate professor, as part of the space technologies study course at the University of Tartu (Olesk & Noorma, 2021). The adopted problem-based learning approach meant that students were involved in every stage of satellite development and deployment, from mission selection to media interactions. Noorma acted as a project supervisor, all other roles were filled by students, from the Bachelor to PhD level.

The name of the satellite – ESTCube – has a dual meaning: it is both the ESTonian CubeSat and the Electric Sail Test Cube, referring to the scientific mission of the satellite. The satellite aimed to become the first mission to deploy in space a component of the electric solar sail (E-sail), a novel space propulsion mechanism proposed by the Finnish scientist Pekka Janhunen (Envall et al., 2014). Following the CubeSat standard, ESTCube-1 measured 10 cm × 10 cm × 10 cm (Lätt et al., 2014).

The project was introduced to the public in 2008 and the satellite was launched in May 2013, as one of 88 nanosatellites launched that year (Nanosats.eu, 2022). Various problems delayed the main experiment and, eventually, the experiment was unsuccessful, likely due to the failure of a motor that was supposed to reel out the E-sail tether (Olesk & Noorma, 2021). Other systems worked beyond expectations, e.g., the on-board camera captured 300 photographs from space. After two years on orbit, the solar panels of the satellite no longer produced enough energy and the last connection with the satellite was in May 2015 (Slavinskis, n.d.).

After ESTCube-1, the project has continued with a new team. ESTCube-2 was presented to the public in early 2022 and launched in October 2023. Communication with the satellite could not be established and the team suspects it did not separate from the rocket and was destroyed.

Figure 1. *ESTCube-1 in orbit, artist's rendition. Source: Eesti Tudengisatelliidi SA*

2.5 MY POSITION AS A RESEARCHER

My interactions with the ESTCube-1 team and several of the researchers from other interview groups did not begin with this research project. Before starting my PhD in 2013 – and for some time after that as well – I worked as a science journalist. Until 2011, I was the editor-in-chief of the popular science magazine *Tarkade Klubi* and thereafter worked as a freelance journalist, mostly affiliated with the biggest Estonian daily newspaper *Postimees*. The interaction was closest with the ESTCube-1 project: I was one of the first journalists to do an in-depth story about the project (in 2008) and, altogether, wrote seven newspaper and magazine articles about them. As a member of the *Postimees* editorial team, I also participated in the internal discussions that led to the selection of the project supervisor as Person of the Year in 2013. Therefore, I acknowledge that my own contribution to the public visibility of the ESTCube-1 project has been significant.

Next to that, I also supported the process of mediatization more directly. When meeting the group and their supervisor for media purposes, these meetings were often followed by informal discussions in which I suggested how to improve their communication and media interactions. Moreover, since 2010, I have regularly given science communication workshops to young researchers in which several members of the ESTCube-1 team also participated. I have described the nature of these interactions and reflected upon their impact in Article II.

I now recognize that my position as a journalist was not to simply mediate research results but also to actively support the public visibility of science. This is in line with the conclusion of Bucchi (2004) that science writers often view their 'professional mission' in terms of popularization. My activities were motivated by the sense that science in Estonia does not have enough public visibility and support, and that the lack of media skills of researchers is one of the main barriers on the way of more and better science communication. In my work, I met researchers who shared the same concern and I had discussions with them about how to improve the situation. Sometimes these were informal consultations, sometimes developed into communication workshops for larger groups but commonly these interactions involved explanations about media logic and journalistic practices.

These experiences guided the focus and main research questions of my PhD project once I moved to the academic setting. I had observed that there is great variability in the media skills of researchers and that, in some cases, their media practices change following media interactions, ESTCube-1 team being the most notable example. The concept of mediatization gave a theoretical foundation to these observations and provided a framework to analyze and conceptualize these changes. The academic perspective opened new ways to think about my previous experiences and made me ask critical questions about the role of scientists in science communication, the autonomy of journalism, the impact of mediatization on science etc.

My personal involvement with the process that I started to investigate made it necessary to carefully consider my position as a researcher. I was no longer able to conduct the study as an autoethnographic or practitioner-based inquiry as I had not documented my previous interactions with the ESTCube-1 team or other researchers. However, the experiences positioned me as an 'insider' who can also take on 'outsider' attributes (Stanley, 2012). The way that Corbin and Strauss (2008) recommend using personal experiences in analysis while maintaining the primacy of the empirical data is to compare incidents from the researcher's experience at the conceptual level to incidents in the data, in order to bring out properties and dimensions of which both incidents are examples (Gentles et al., 2014).

Personal accounts have the same limitations as every (auto)biographical writing, namely that such knowledge is contextual, situational, and specific (Stanley, 2012) and can be affected by biases, selective memory, and errors. I have done my best to avoid such traps through "a commitment to reflexivity" (Malterud, 2001, p. 484), where reflexivity is defined as "the process of a continual internal dialogue and critical self-evaluation of researcher's positionality as well as active acknowledgement and explicit recognition that this position may affect the research process and outcome" (Berger, 2015, p. 220).

In addition, I made efforts to clearly separate my roles as a researcher and a journalist/media trainer: I had no media interactions or engagements in other professional roles with the researchers after I had designed the study involving them.

Finally, I believe that such a relationship between researchers and a journalist, as I have described in the case of me and the ESTCube team, is not unique, at least not in Estonia. In a small society, it is easy to create close relationships when certain objectives align. Therefore, if journalists have a professional mission to support the public visibility of science and there is interest among scientists to improve their communication and media skills, such informal collaborations are likely to occur. My conversations with other Estonian science journalists have confirmed that others have also built similar relationships of varying depth.

3. EMPIRICAL FINDINGS AND ANALYSIS

The results presented in this section are based on 22 in-depth interviews with researchers in various positions, and the analysis of media content about ESTCube-1. All interviewed scientists can be considered mediatized or involved in processes with mediatization as a potential outcome, as was judged in the sample selection process by their personal visibility or institutional position and, later, confirmed with the interviews.

The four studies that this thesis is built upon explore various facets of micro-level mediatization in science: process, indicators and impact.

3.1 PROCESS OF MEDIATIZATION

Mediatization itself is often conceived as a process and, as will be discussed later, there can be various levels of being mediatized. Therefore, to avoid confusion, it is important to clarify that in this section, a 'process of mediatization' is understood as a process through which mediatization starts or changes its intensity, in response to conditions and drivers in the outside environment or individual perceptions. The ESTCube project presents an almost ideal case to describe such a process at the micro-level because its rapid transformation from a media-naïve to a media-skilled group enables the characterization of the contributing factors. First, however, I will map markers of mediatization in Estonian science institutions to provide a context for the processes at the micro-level.

Interviews with decision-makers from Estonian science organizations (universities and other research organizations, science funding bodies and scientific societies) indicate that media is considered an actor with increasing importance for the organizations. The organizations have adapted their structures to support the increasing need for publicity and also display adaptations in the cognitive and evaluative orientations regarding media and its relationship to their organization (see **Article I**).

The organizations bring out two main objectives for media visibility: influencing political decision-makers and increasing the public image of the organization. Both are considered vital for the functioning and development of their organization as well as science in general. While the small population of Estonia means that the organizations have good direct access to decision-makers, they admit to using media to build their agenda and put pressure on politicians who "largely react to what is currently in the media" (Interview D1).

> *"We give our messages also directly [to politicians] but this does not have the same influence as going through the public debate."* (Interview D3)

> *"For some ideas to become accepted in the parliament or the government, they need to be tested somewhere. It would be a shame not to gather feedback through media."* (Interview D6)

The respondents report that using media is effective, both for putting major policy issues in the political agenda (e.g., by using public joint declarations by university rectors) and for solving smaller problems of the organizations:

> *"The media efforts have paid off. . . . Several things were quickly solved once there was media fuss."* (Interview D7)

The second important publicity objective for organizations is to maintain and improve their public image, mainly by providing positive stories. Here, reports about research have a central role but rather than demonstrating scientific excellence, the organizations want to show contributions to society. This was especially emphasized by the smaller universities. The positive public sentiment towards the organization is associated with a stronger position in interaction with political decision-makers, increasing trust for science in general but also with being more attractive to potential students.

The two main aims of media visibility – cultivating a positive image (of science and their organization) and influencing the decision-makers – are combined in the topic of science funding. There is a general expectation among the interviewed science decision-makers that a positive image of science among the population will translate into political support for science funding[5].

> *"Media is very important in turning the political will into a political action. [Media can] make a rather large number of Estonian want the same thing and vote for the government who really wants to deliver this."* (Interview D6)

The organizations see that media has been a good partner for them in achieving those objectives. At the same time, they also feel that media has little organic interest in these topics and, therefore, the organizations themselves need to make efforts to "get into media". While all the organizations have communication/public relations offices, the science decision-makers expect individuals in their organization to strongly engage in communication by participating in public discussions and promoting their research results or other activities.

> *"In a country as small as Estonia, media coverage of a topic greatly depends on how eager and skillful [communicator] the top researcher in that area is."* (Interview D6)

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[5] The interviews were made in 2016. In 2018, following strong public pressure, scientific organizations and major political parties signed a commitment to increase public funding of science to 1% of GDP over the next four years. After the elections in March 2019, the new coalition did not allocate the funds foreseen in the commitment, citing a need for budget cutbacks. They revised the decision in 2020 and provided the promised level of funding.

> *"We have a principle that we invite only the best to be our teachers. Those are people who are active in their [creative] field, including participating in public debates concerning their field of expertise."* (Interview D4)

> *"I think that every institute has some house journalist to whom they can turn when they have a story."* (Interview D7)

> *"My dream is that at least all our heads of departments, and in the future, all senior specialists would be people with the qualification and capabilities to write generally understandable articles about their specialist subject."* (Interview D1).

The interviewees mention several activities that their organization has done to support scientists in dealing with media. These include encouragement to write articles for the public and providing editing or publishing support, organizing media training courses and integrating science communication activities into the career model. In addition, the organizations mention steps that are meant to support journalists (for example, compiling a list of scientists who are willing to be the spokesperson for a topic) or have a defensive nature, for example: "identifying situations where media coverage can have a significant negative impact on reputation" (Interview D2).

The latter quote reflects the prevalent understanding among science decision-makers about media logic: that media prefers and amplifies stories that involve conflict or a negative aspect, and presents them in a tabloid-like manner to gain 'clicks'. For the organization, being involved in such media visibility includes a threat to the reputation and trustworthiness of the organization (and science in general), leading them to adopt the proactive position of providing the public with positive stories, as was described above. At the same time, the decision-makers do not feel the need to comply with this conflict-driven click-bait media logic to gain visibility. Being simple and clear, relating topics to the everyday lives of people and maintaining a good, personal connection with journalists are described as effective pathways to visibility that work both for the organizations and the decision-makers personally. Several respondents said that they personally would have no problem getting their article published in the media. This is not perceived to be a result of certain adaptations to media logic, rather an indication of solid collaboration with newspaper editors.

> *"If I personally want to influence something then I will grab a pen and write. Or call a familiar editor and make an agreement on how to act in order to achieve the goal."* (Interview D4)

> *"We have an unusual situation in Estonia in the sense that we have an especially good relationship with media. . . . We can make agreements that sensitive information is used but not published, and that some things will be published at a certain moment. . . . We use this on a daily basis. . . . A couple of times we have had the occasion when we definitely need to publish some message to gain a better position in negotiations with ministers. Again, the*

editors have agreed to publish because they understand the need for this." (Interview D6)

In summary, the decision-makers in science organizations consider media visibility a vital resource and see the need for their organization to take a proactive role in the relationship with media. Increased media visibility – if it is positive – contributes to strengthening their position in relation to other actors (especially political decision-makers), the respondents believe. The science organizations' management also expect individual researchers or research groups to engage with media directly and have provided mechanisms for them to support this. A key adaptation, described by the respondents, is establishing personal relationships with journalists. These relationships, by instilling journalists with a stronger sense of responsibility towards their sources, help to circumvent the tabloidization and focus on conflicts that is believed to be the dominant logic of media. In some cases, the collaboration with newspaper editors may be even perceived as a sign of media adapting to the needs of the research organization. Due to all this, the respondents did not express the need for substantial adaptations to media logic in order to achieve media visibility or describe adaptations that could be interpreted as impacting the core values of science. However, we must keep in mind that these conclusions are based on self-reported practices and therefore might not allow the depth of adaptations to be fully estimated.

ESTCube, in many respects, has been a dream project when judging by the standards of the science decision-makers: it sent out positive and inspiring messages, received high media visibility and was initiated and conducted on the level of a research group. At the same time, media visibility was originally not a goal of the project, the team leaders admit. The team members had no previous media experience and, at the start of the project, did not plan a significant media presence. By the end of the project, however, the interviewed project members self-reported knowledge about media logic and confidence in handling media interactions. Investigating the transformation of the project from the media-naïve starting position to one of the most media-visible research projects in recent Estonian history enables key factors that are driving the process of mediatization to be localized.

For ESTCube-1, interviews with team members revealed three main factors that helped to become team members confident in media interactions: (1) encouragement by the project leader, (2) reflections on media experiences, and (3) participation in media trainings. These factors are also elaborated in **Article II**.

3.1.1 Role of project leaders

The project supervisor Mart Noorma accounted for the most media appearances during the project (see Table 3, p. 41) and was the primary face of the satellite team in the public. He, too, was media-naïve at the start of the project:

> *"I had no experiences; I just thought you have to talk about your thing as well as you can. Our first ideas [about communication] were amateurish."* (Interview E1)

The experience that alerted him to the role of media and its potential impact on the project was the media interest that followed the first press release of the project, issued shortly after he had put together a core team of students. The release was meant to attract more students to join the project but the team did not anticipate the kind of media attention that followed. As the project was in a very early phase, they were not able to answer many questions that journalists had, for example, about the mission of the satellite. This diminished the credibility of the project, according to the project supervisor (Interview E1), which he perceived as a threat. For him, the solution was to develop an understanding of media logic so that he would be able to better control future media interactions and deliver messages more effectively. The main factors contributing to his mediatization were the same as presented in the next sections – reflections on media interactions and discussions with journalists, including myself, that can be considered equivalent to a media training.

In the student team, the team supervisor, together with the project manager adopted the principle that public communication will also be handled by the team members themselves. This decision reflected the general problem-based learning approach of the project. According to this approach, the best way to learn communication skills is by practicing them and by independently working out solutions to the problems that occur in the process. Later in the project, distributing media-related tasks to students also helped to decrease the public speaking load of the project supervisor. Besides media appearances, public communication tasks involved public presentations (e.g., in schools).

Whenever possible, the team leaders tried to give the junior team members opportunities to practice communication skills, e.g., give interviews to media or publicly present the project. The ESTCube-1 press conferences[6] consisted of a series of short presentations by students, for example, each leader of a subsystem provided an overview of their section of the project.

While these efforts of project leaders fulfilled their aims by end of the project, the team leaders admit that the process was "painful" and "challenging". Students were initially reluctant to speak publicly or interact with media, the understanding of the value of this activity only came during the process.

> *"People have come and told me later that now they understand why you made me talk about this subsystem at the press conference. The communication side, the requirement to talk about what you are doing, is something they did not get anywhere else during their studies."* (Interview E3)

[6] The team organized four press conferences: on occasions of selecting the E-sail as the scientific mission, finalising building of the satellite, the one-year anniversary of the launch, and end of the mission.

> *"This is also one skill you can learn in a hands-on project. I would say that maybe 30 percent of what we do is not scientific or technical, it's management and such things, [including] public relations."* (Interview E8)

Next to facilitating opportunities, the project leaders supported the mediatization process also by involving team members in communication planning, giving feedback after public appearances and being a role model themselves. All of these were mentioned in the interviews as factors that helped the team members to improve their media and communication skills and lead to an appreciation that communication is a necessary part of science and benefits both science and society. With all this, the project supervisor managed to normalize media interactions for the team.

> *"[The project supervisor] is really good at finding the right expressions, this is a complicated thing. Before the final press conference, we discussed how to formulate, what to emphasize or not to emphasize. For example, when it became clear that the solar panel productivity is falling, we agreed to say that we completed the mission before [the power supply] went crazy. This actually was the case but we wanted to emphasize that it wasn't that we had to finish the mission because we had no energy left."* (Interview E7)

> *"If [the project supervisor] wouldn't use media as much as he does then most likely I wouldn't see media as such a powerful tool."* (Interview E8)

3.1.2 Role of media training

Four members of the ESTCube-1 team (interviewees E2-E5) took part in a media training course, taught by me. The course included a theoretical introduction to science communication, an overview of news values and a journalist's decision-making process, advice for interactions with journalists and for popular science writing. The course concluded with a practical task to prepare a newspaper lead paragraph based on a scientific paper.

Mostly, the course helped the participants to understand journalists and gain tips on how to prepare messages for media, they said in the interviews:

> *"You showed what it is the journalists view on selecting news when they get so many messages every day. How little time they actually have to write something."* (Interview E2)

> *"Widening the world-view was definitely the most important thing. You don't think about how the article actually gets prepared and how many points there are that you have to take into account."* (Interview E3)

> *"It gave some general principles that make a lot of sense when you think about them: such as saying the most important things in the beginning. I found it interesting that when we launched ESTCube-1, my Facebook post was used verbatim by [the public broadcaster's main news show]* Aktuaalne

Kaamera. *Maybe we learned how to summarize the most important thing well.*" (Interview E5).

The effectiveness of the training is highest when combined with actual media experiences, according to one respondent:

> *"It is perfect when you first get a taste [of media interactions], then get [the science communication theory] systematically and then you can again continue with practice."* (Interview E3)

Special media training is a concentrated way to learn necessary knowledge and skills for successful media interactions. But it is not the only one. Alternative routes include self-educating with guiding materials, deriving the principles from practical experience or consulting with more experienced colleagues or journalists. As mentioned earlier, extensive discussions with journalists provided the project supervisor with basic understanding of media logic. When upcoming and completed media activities were discussed at ESTCube team meetings, basic principles also reached team members who did not participate in the media training course.

3.1.3 Role of media interactions

Besides reflecting on communication activities (press conferences, interviews and other media coverage) during group discussions, all interviewed team members also said they analyze their media interactions to identify shortcomings and find ways to improve the clarity and focus of their message, especially during interviews. In some responses, this was combined with an awareness of target groups.

> *"When you give an interview and later see the result, then these are two completely different things. Then you wonder why did it not come out the way I imagined it could? . . . I do try to think how I could make it so that certain things would get written [to the article] the next time."* (Interview E2)

> *"The learning process was really intense in the beginning, after each interview I did some self-critical thinking about what could have been said differently or more clearly. In the beginning it wasn't quite clear for us how to make the point or reach the target groups. This needed a lot of polishing, thinking how to formulate the message so that it is not too complicated and would actually reach the target group. . . . You need to illustrate, give examples, and consciously think about who you are talking to."* (Interview E3)

> *"The selection of the audience, giving the whole picture and story-telling – these are mentioned so little. This sounds very simple but [it is hard] to understand what it means. You have to see it yourself, try by trial-and-error."* (Interview E7)

The team members adopted practices that helped them to gain more control over the interactions: requesting preparatory information about the interview (channel,

format, questions, length), preparing key messages, and, in case of print article, asking to preview the draft.

> *"I realized that I could have more standard answers ready for myself so I would not need to start thinking in front of the camera. . . . During my last radio interview, I had a page with all the things that could be asked. There I had the answers, at least on the level of keywords."* (Interview E7)

> *"I have learned that there is a difference between one journalist and another. . . . I have learned that every journalist will do it their own way. For example, the private channels always attach some intrigue to the story, while the public broadcaster takes the position of a neutral mediator. Knowing this, one has to take into consideration that one should already have prepared the [appropriate] message one wants to transmit."* (Interview E1)

The group adapted their media strategies in the course of the project, shifting the focus from press releases to press conferences and personal contacts with journalists:

> *"I have learned that a press release is not the best device. . . . [When preparing to release some news] I would make agreements with newspapers that are ready to put the news on their front page or write a longer article. . . . I would make separate deals, give them material so by the time we issue a press release, certain channels are professionally prepared and ready to gain a certain advantage. I will help them to gain this advantage."* (Interview E1)

I also asked the team members how they would design communication activities in some future project. ESTCube activities clearly served as a model for the mentioned activities and respondents saw themselves devoting personal resources to media relations.

> *"Even if it doesn't get published, some kind of [publicity] material should be produced."* (Interview E7)

> *"It depends on the project and the point we would like to communicate. Depending on this, the activities could be press conferences or just news pieces or longer articles in some popular science magazine or in an outlet for decision-makers. . . . I would make sheets with background material for the press that can easily be cited, used everywhere where necessary, along with photos or images."* (Interview E3)

> *"I have seen it's important to have a few journalists to keep in close contact with. I also now know a few journalists and I think that this is one step for establishing a communication in which the media is responding to what you do, what you suggest."* (Interview E8)

3.1.4 Process of mediatization among other interviewed scientists

Interviews with respondents from other groups did not reveal patterns as clear as in the case of ESTCube-1. The contexts in which their media interactions started were different, the learning process was not as intense and its factors were less clearly distinguishable. For example, none of the respondents in the 'decision-maker' and 'visible scientist' groups had participated in media training workshops, nor did they mention any significant role-models. Both of these could be explained by the fact that many of the interviewed scientists started their scientific career before the 2000s when media trainings started to become available and science communication became more accepted in the scientific community.

The respondents attributed their skills mostly to experience gained during previous interactions with media, but also attached importance to personal characteristics or a natural communication skill. Several of them suggest that they have an ability to explain complicated things in a simple and clear way and this accounts for media's interest in them. They described the main mechanism that sustains their visibility as media-led, meaning that most interactions are initiated by media, e.g., calling them and asking to comment on a recent scientific discovery or public discussion. Their visibility started, however, often due to personal efforts, e.g., publishing opinion articles, giving public presentations or contacting journalists to promote their work. The motives for public communication are varied, from simply the wish to popularize their work or science in general to strategic aims such as influencing stakeholders.

> *"When the number of students is falling everywhere now, it is clear that if you do not start [popularizing your subject] at the grassroots level, then there is no hope that in, say ten years, there is anybody here. . . . If you are more visible in media then the number of direct contacts – with journalists and everyone – springs up like mushrooms. There are also many more requests from schools."* (Interview V2)

> *"It is obvious that the success of our work and opportunities to do our work largely depend on what people – those average people that do not exist – think of us. Because inevitably their attitudes reach politicians and though politicians it reaches both legislation and funding."* (Interview V4)

> *"[The decision to start discussing the topic in the media] was the result of a long process during which all other possibilities to influence [a specific] policy process had deadlocked."* (Interview V5)

From these personal stories emerges a side-observation of this thesis: there can be several *pathways to visibility*, i.e., mechanisms by which media presence is created and sustained. The responses from the interview groups about the start of media interactions enables some of the pathways to be distinguished. These include the following:

– media-driven visibility: interactions are initiated by journalists who use the scientist more or less regularly as a source. Media's interest may come from,

among other possibilities, the research topic, the communication skills of the scientists or simple convenience;

- position-driven visibility: the scientist is required to communicate publicly because of his/her position, e.g. being president of a university or head of a scientific society;
- strategic goal-driven visibility: scientist initiates media interactions with a specific purpose, e.g., to attract students, funding or collaborations, promote an event, influence policy or public debate;
- personality-driven visibility: scientist enjoys public communication.

Several mechanisms can play a role in the visibility of a person or a research group. In the case of ESTCube-1, one can see that both the charismatic personality of the project leader and a strong sense of a strategic goal drove much of the media visibility that was then sustained by the media itself, by starting to use the team members as sources in all space-related issues. In addition, other mechanisms are also possible. For example, the interviews with the science decision-makers indicate that organization-driven visibility is a plausible mechanism – an organization can mandate communication (e.g., by grant requirements or job descriptions) and/or provide a platform for this (e.g., blog, video series). The lack of this type of visibility among my respondents might reflect the fact that active use of such activities by organizations is a fairly recent development.

The presented list is not exhaustive, nor has the aim of the thesis been to produce one. Nevertheless, the various visibility pathways that are evident in this small sample should be a demonstration of the diversity of communication experiences among scientists. In the context of mediatization, this will lead us to the question of whether different pathways and the involved factors that are guiding the process (such as communication objectives or micro-institutional affordances, see van Dijk et al., 2011) are shaping scientists' relationship with media in a way that can also produce variable outcomes. Are the scientists whose visibility is media-driven differently mediatized than those whose media interactions are driven by a strategic goal? That is, whether these pathways and accompanying adaptations help to explain the various roles and formats where scientists occur in media?

While the part of the question that concerns the role of pathways remains to be fully explored in further studies, this thesis now proceeds to offer indicators to evaluate differences within mediatization.

3.2 INDICATORS OF MEDIATIZATION AND TYPES OF VISIBLE SCIENTISTS

The purpose of developing indicators is twofold. First, by identifying the indicators we describe the essential elements of micro-level mediatization. These are the

hallmarks by which mediatization can be recognized and which reflect the functional adaptations taken by the individual or group to benefit their relationship with media. Second, the indicators provide tools to investigate variabilities within mediatization, as discussed above, and evaluate the level or intensity of mediatization.

The indicators provide a different perspective compared to previous typologies of visible/mediatized scientists. The focus of Horst (2013) was on the identity of the communicating scientists, Väliverronen (2001) looked at the function of the scientist in media texts and Rödder (2009b) based her typology on the dimensions of tolerance of media-oriented communication and perceived relationship of science and society. All of them help to explain the role of scientists in media but tend to lack the dimension of agency that is provided by mediatization approach. Therefore, the focus of these indicators is on the relationship with media logic and the related media practices. This is closest to the work of Scheu (2014, 2019) who has defined mediatization strategies, based on perceptions of media logic and their implications on media practices, but on organizational level actors.

I used the ESTCube-1 data to develop the indicators by analyzing the responses for functional differences in team members' media-related attitudes and practices. This resulted in five dimensions for evaluating the mediatization of scientists. These were then validated on a group of visible scientists and used to develop basic types of mediatized scientists. The ideas in this section are also outlined in **Article IV**.

The five dimensions that provide the indicators are described in Table 5 and combine scientists' media-related attitudes and self-reported adaptions.

Table 5. *Five dimensions that provide indicators for evaluating the mediatization of scientists (Source: Article IV)*

Dimension	**Indicator description**
Communication as a responsibility	the extent to which the scientists see public communication as part of their professional responsibility
Awareness of media logic	the extent to which the scientists express awareness of media logic and feel confident in using a journalistic news style to address the public
Mastering media logic	the extent to which the scientists feel confident in mastering media logic and using it to trigger media coverage (via press conferences, press releases, directly contacting journalists) or introduce angles relevant to them
Purposeful use of media	the extent to which the scientists see media as a tool for achieving their scientific or non-scientific aims
Institutionalization of communication activities	the extent to which the communication activities in the research group/organization have been institutionalized within the professional activities of the scientist

The first dimension explores scientists' perception of the role of communication in their daily work. It reflects the interest or perceived duty to communicate with the public, a necessary premise for the mediatization process. In this dimension, the intensity of mediatization can be evaluated by the relative importance that is attributed to (media) communication. For example, while all respondents from the ESTCube-1 team agreed that communicating their work is important, some place it on a more equal position in relation to their research than others.

> *"I have learned that media interactions require work. And that this work should not be condemned. You cannot feel ashamed for advertising your work."* (interview E5)

> *"[Communication] cannot be done as something on the side; this is work like any other. But when I do it, this comes at the expense of my scientific work."* (interview E7)

The second and the third dimension focus on various aspects of media logic, exploring both the perceptions that respondents have about the characteristic operational logic of media and the adaptations that they have undertaken to respond to this perceived logic. The premise for mediatization here is the recognition that media follows certain principles in the news selection and presentation processes.

> *"Things got a lot clearer the moment when we realized that you shouldn't just randomly try things but there are certain principles of how to formulate our messages to the media."* (Interview E1)

Other aspects of media logic concern, for example, the daily routines and typical interaction practices of journalists (such as understanding the time pressure). According to the model of mental mediatization, the perceived principles of media logic lead to an understanding of what is necessary to do to gain better control over the interaction process and produce the outcome expected by the researcher, whether it is a more accurate report or increased media visibility. The resulting adaptations become indicators of mediatization.

The two dimensions of media logic reflect various levels of scientist agency. The dimension „awareness of media logic" evaluates interactions with journalists where the scientist is in a responsive position, e.g. interviews; the dimension "mastering media logic" concerns the possibilities for the scientist to take an active role in initiating and sustaining media visibility.

In the dimension "awareness of media logic", the adaptations reported by the ESTCube team members include adjustments in the style of expression and level of complexity but also an active preparation and reflection process, including requesting to read the final draft of the news article.

> *"I like to ask for information [about the interview] via e-mail. This gives me time to think what to do with it. What message could I communicate, has there been anything new or exciting recently that should be highlighted, who is*

the target group of this publication. I like to think these through and respond properly." (Interview E2)

The descriptions by the ESTCube team leaders about how they managed the media relations during the project (see quotes from interview E1 in sub-section 3.1.3, The role of media interactions) illustrate the dimension "mastering media logic". As shown in Article III, the satellite project was visible in Estonian media almost constantly throughout the duration of the project. Much of that visibility was due to activity initiated by the team, achieved not just by exploiting media news selection routines (by publishing press releases and organizing press conferences) but also by calibrating their messages to maximize both visibility and transmission of their agenda.

The fourth dimension evaluates the communication objectives of the scientists or, more specifically, the level to which public communication is instrumentalized to serve these objectives. For example, the self-reported motives among ESTCube team members range from introducing the project to the general public to ensuring political support for Estonian membership in the European Space Agency. Estonian science decision-makers (see Article I) also admit to using media for (political) influence. Whereas they themselves confess using it on rare occasions, they tend to attribute such practices routinely to other actors, including other scientific actors. The relevance of communication objectives for mediatization lies in the premise that some objectives require more elaborate adaptations to be achieved, either by requiring more media visibility or better skills in getting the suitable agenda and frames to the media.

The final dimension evaluates the extent to which the public communication activities have been institutionalized within the working routines of the research group or the individual scientist. Examples of institutionalized practices may include early or regular involvement of an institution's communication specialists to plan communication activities, preparation of a communication strategy for a project, arranging a social media presence and setting up routines to update social media, and taking photos or videos during field work to use them later for public communication. Once institutionalized, such micro-level adaptations can create interaction patterns that become adopted by other scientists, research groups or even on the organizational level, thus advancing mediatization. In ESTCube, it was evident how the supervisor had become a role model for the junior team members: his media practices were often suggested when the team members were asked how they would design communication in potential future projects.

Given the small sample and specific characteristics of ESTCube, one might question the universal validity of the identified indicators. Therefore, I applied the indicators to a more diverse group of visible scientists and analyzed their relationship with media to identify other possible dimensions of mediatization. The analysis confirmed

that the five proposed dimensions adequately cover the functional elements and enable variability in the mediatization patterns to be seen and described.

The indicators need to be evaluated qualitatively and the intensity of mediatization is estimated by the adaptations that are performed or required. Adaptations that show stronger alignment with media logic are evaluated as an indicator for more intense mediatization. Similarly, expressed attitudes and objectives that would require more extensive adaptations to media logic are considered a hallmark of more intense mediatization.

This approach enables individual patterns of mediatization to be produced, but as there are no fixed scales for the dimensions, it is more useful as a tool for comparison. Figure 2 exemplifies how the visible scientists (concerning the dimension "Purposeful use of media" and using example statements to illustrate their position) are positioned in relation to one another to reflect differences in their level of mediatization.

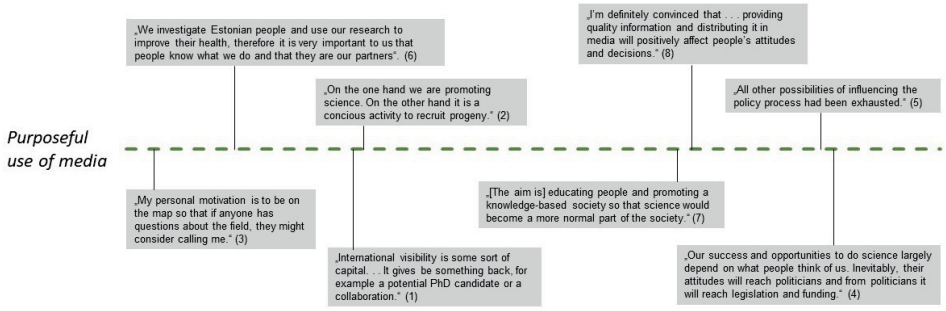

Figure 2. *Example of indicator analysis in the process of creating patterns of mediatization, based on the group of visible scientists. (Source: Article IV)*

When I did the same exercise with all indicators, using the responses from the visible scientists' group, clusters occurred. Based on these, I propose that we can distinguish two basic types of mediatized scientists, reflecting the varying extent of their media-related adaptations – *adapters to media logic* display lower intensity mediatization and *adopters of media logic* higher intensity. The main characteristics of both types are presented in Table 6.

The distinction does not indicate that one type would be better science communicators than the other. Both types are capable of receiving good media visibility and might be perceived as skillful communicators by the public. Also, we might be able to construct more types based on the relationship that scientists have with media (see, for example, Scheu, 2019). The purpose of defining these two types of mediatized scientists is to illustrate how similar media visibility might be based on different skills, objectives and adaptations.

Table 6. *Basic typology of mediatized scientists (Source: Article IV)*

Dimension	**Adapters to media logic**	**Adopters of media logic**
Communication as a responsibility	See it as important but secondary to their scientific work.	See it as equally important to their scientific work.
Awareness of media logic	Are able to explain their work in simple terms and feel confident giving interviews. Criticize journalists' routines.	Are able to understand and accept the journalists' work logic, and express themselves in a journalistic news style.
Mastering media logic	Are not familiar with news production practices; write an occasional press release; otherwise do not initiate media coverage.	Contact journalists proactively and manage to 'sell' stories and angles to them.
Purposeful use of media	See media coverage as benefitting the current project or result (getting attention, increasing awareness about an issue *etc*.).	Have more strategic aims (wider benefits to science, economy *etc*.) and think in terms of *target groups* and *messages*.
Institutionalization of communication activities	Perform communication activities on an *ad hoc* basis.	Conduct communication activities systematically and follow a strategic plan, integrating public communication into the professional activities of the scientist.

The presented types are ideal types and the interviewed scientists tend not to belong neatly in one or the other type. Evaluating their mediatization characteristics on the proposed dimensions, however, gives us some clues about the questions surrounding the role of pathways presented at the end of the previous sections. We see that the respondents who have internalized media handling skills and use them consciously to manage media attention are more likely to be leading an institution or major project, or be a public champion of a specific topic. We can thus hypothesize that while the types are not generally pathway-dependent, position-driven or strategic goal-driven mediatization are more likely to lead to more extensive adaptations.

The terms used to describe the types (*adapting* and *adopting*) are the same as those used by Strömbäck to describe the phases of mediatization (Strömbäck, 2008). Yet, it would be misleading to consider the types strictly as different phases of mediatization, since we see more flexibility in the individuals' relationship to media on the micro-level. For example, several respondents seem to switch between the

types, depending on the situation. They adopt a proactive role for one project or topic but choose to remain responsive with other topics. At the same time, it is true that the *adopters of media logic* show more extensive adaptations and this also means that they possess a bigger toolbox of media skills.

In summary, defining the indicators of mediatization and the types of mediatized scientists gives us better tools to analyze micro-level mediatization. It especially opens possibilities to understand the processes leading to and initiated by each characteristic dimension of mediatization and discuss their functions in the context of science communication.

3.3 IMPACT OF MEDIATIZATION

So far, this thesis has mostly described adaptations in media-related attitudes and practices of individuals and research groups in response to the perceived logic of media, with the aim of gaining more visibility or better control over media interactions. While I argue that this mechanism also initiates processes that lead to meso- and macro-level changes, the focus on adaptations in media practices admittedly represents just one possible section where mediatization presents itself. When talking about mediatization of science (not just mediatization of scientists), we look for how the changing attitudes and practices of scientists are starting to mould science as a social institution, its values and distinctive characteristics. In addition, keeping in mind the definition of mediatization as an interrelation between media and society, it is worthwhile to think about what kinds of responses in media the mediatization of sources might bring. By definition, any changes in this interrelationship become a part of mediatization. It is necessary in this section to clarify that by *impact of mediatization*, I mean the changes beyond the described adaptations in media practices. Specifically, I will discuss the deeper-level changes in the ESTCube project team (also covered by **Article II**) and indications of a mediatized interrelationship in media coverage of the project (**Article III**).

3.3.1 Possible impacts on science

When using Peter Weingart's framework of levels of changes in the mediatization of science (Weingart, 2012, p. 27), we see that the adaptations described in previous sections largely belong on the level of interactions. The expected level and quality of visibility are achieved through gaining an understanding of journalistic logic and developing adaptations to this such as specific interaction patterns with journalists. Science decision-makers also refer to organizational level practices to support public visibility, such as working together with communication offices to influence societal actors and establishing mechanisms to support journalists in finding information and experts. All adaptations are framed as supporting the general aims of the scientists or the science institution but not affecting, in any way, the content of the scientific work. Curiously, the interviewed visible scientists (or the ESTCube-1 team) did not

report using the organizational level mechanisms in a significant way for their media activities. Therefore, the relationship between changes on various levels needs further investigation.

The deepest level of changes in Weingart's approach is where adaptation to media logic leads to the replacement of scientific criteria for evaluating scientific work and results with media-related criteria. All interviewees rejected the notion that this is happening in science, although some suggested individual attempts to influence funding decisions via media are occasionally made. That is, according to the anecdotes, some research teams try to initiate positive media coverage hoping it will benefit their grant proposal during the ongoing evaluation process. While a sidenote in the discussion about the mediatization of science, such claims nevertheless demonstrate a readiness to attribute beliefs to other scientific actors relying on the media's ability to influence core scientific criteria.

The fourth level proposed by Weingart, situated between interactional and system level in the extent of changes in science, is the program level. This level concerns the choices of, for example, topics, theories and methods. An indication of the mediatization of science would be if the decisions of scientists tended to favor the method or topic more likely to grant publicity. The case of ESTCube-1 presents some intriguing indications about changes on the program level.

First, it can be asked whether the whole ESTCube project might be looked on as a program level change in science, considering the huge public visibility it received. The team members assert that media visibility was not a motivator in the project initiation and design. The core features of the project were designed for the purposes of education – to offer the students a more hands-on problem-based learning opportunity that would give them a variety of skills expected by the labor market. The project idea was designed to be attractive for students and its attractiveness to the public was discovered almost accidentally. However, once the power of media visibility was understood, it became a firm part of the legitimization exercise of the project, required because of the educational, scientific and societal novelty and ambition of the project[7]. ESTCube's success likely played a role in the series of similar projects that have followed in Estonia, such as the student satellite project of Tallinn Technical University[8] or the self-driving car project Iseauto[9]. If potential media visibility is part of the motivation for designing such projects, this is an indication of program level change in science.

Whereas, as discussed, ESTCube did not report public visibility as a factor in the design choices of the satellite, some of the decisions were fortunate in terms of media use. Foremost, this concerns the satellite camera. They initially had vague plans to

[7] Such creation and exploitation of public support may hint at another avenue for system level change in science.

[8] http://satelliit.taltech.ee/

[9] https://autolab.taltech.ee/portfolio/iseauto/

use a camera for "popularization purposes" (Interview E1) and equipped it with better hardware than would have been necessary for the experiment. Then, because of the problems with the main satellite experiment, the camera became the central feature to present during the time in orbit. The team made efforts to maximize the visibility it offered, e.g., by timing the release of the first image of Estonia with the press conference they organized on the occasion of the satellite's first year in orbit.

> *"[The camera] is a success story that we emphasized a lot when we did not have much to say about the e-sail. We could talk about the camera, show a lot of material. . . . We wanted the first picture of Estonia to be ready by the press conference of the first anniversary [of the launch]. This was a motivator; we worked hard to get this picture."* (Interview E1)

The images were widely used on ESTCube's social media channels, including for engagement purposes such as contests. The camera was not the only example where the team expanded the use of existing technical features of the satellite or devised new uses for visibility purposes. On its first anniversary, the satellite beamed a special Morse-code signal so that media could "have a 'beep' in the news" (Interview E1). Also, the satellite team launched a website where people could upload Valentine's Day wishes to their loved ones which would then be sent to the satellite and stored in its memory. While presented as a public engagement exercise, its potential for media visibility was not overlooked – the team sent a press release and invited a TV-crew from the main news program.

In summary, the evidence for program level change in ESTCube-team is not clear-cut. The team adjusted some features of the project to serve the purposes of visibility, but no characteristic of the project was designed solely with this aim. Partly, this is because the team started to consider opportunities for public engagement and media visibility at a stage where most important technical decisions had been made. Previous media experience would have made them take visibility needs into account in the design phase, one team member suggests:

> *"We could have considered some small things that do not affect the energy [use] and the mass [of the satellite] if we had had more contact with the media and the public [in the beginning]. . . . We would have changed the technical solutions to some extent to better engage the public."* (Interview E3)

The relationship between media visibility and project properties was also discussed by a respondent in the visible scientists' group. The scientist works in robotics and one of her projects features robot turtles for underwater archaeology. According to her, potential visibility did not play a role in the design of the project or the robots but she is very aware of the publicity potential that the robots have and exploits it intentionally. When a journalist contacts her:

> *"then I think about what the news value is for the journalist. With robot turtles, for example, it is the cute-factor. I have remorselessly benefitted from its existence."* (Interview V1)

She feels that the practice is wide-spread in her field and sometimes used just for the sake of gaining visibility:

> *"That cute-factor is so terribly important that sometimes it is embarrassing with what one can get to media just because they have a cute robot. This is exploited in cold blood."* (Interview V1)

On the macro-level, we can talk about mediatization of science once the changes described by Weingart are embedded into institutional practices. On the micro-level, described in this thesis, we rather focus on individual attitudes and practices that can lead to institutional change when adopted more widely but can also meet (institutional) resistance and remain an isolated occurrence. We see that – to a varying extent – elements related to each level of change are present in the interviews. The changes on the interactional and organizational levels are more common and accepted, while practices related to program level and systems level change tend to be attributed to other actors.

Finally, ESTCube presents an example of a change on the level of interactions where the final target group are not the media or the public but project team members. Since the project participants were students collaborating largely on a non-curricular basis, it was important for the project leaders to support their motivation. Several project characteristics supported this objective, including choosing a challenging scientific mission, giving the students a high degree of responsibility and collaborating with industry (Olesk & Noorma, 2021). In this context, media interactions were used to amplify and legitimize some of the messages that project leaders believed would support the students' motivation, e.g., that their work on the project has a wider purpose and is appreciated by the society. The project supervisor explains:

> *"We could not have achieved what we did with ESTCube if the aim had been to do something small that people do not understand. . . . The message [that electric solar sail is a revolutionary advancement] was not for media, it was for our own students: the feeling that they are doing something important for mankind is what makes them work day and night."* (Interview E1)

Another motivating effect of media interactions was noted by one team member:

> *"The decision we made in the beginning to speak about the project publicly and interact with media certainly put additional responsibility on the team and created some stress. But on the other hand it also made us take the responsibility to really finish the project and not to give up."* (Interview E5)

3.3.2 Media coverage of ESTCube-1

So far, I have focused on the adaptations of scientists and science organizations to media logic. Although mediatization is an interrelationship between media and social institutions, it is logical that the institutions feel a stronger impact, considering that the driving resource of mediatization – public visibility – is owned by media. However, it is also plausible that the changed interaction practices of its sources can also have an effect on how media covers science and uses scientific sources. The thesis is not able to provide an in-depth look into possible mediatization impacts on media but an overview of ESTCube-1 media coverage might give us a few indications of the processes at work.

The main assumption for media analysis is that by understanding and exploiting media logic, mediatized scientists are successful in maintaining visibility and inserting their agenda and framing to the media coverage of their work. The following analysis (also presented in **Article III**) is based on 30 press releases issued about ESTCube-1 and 160 original media items produced about the project. The media sample included 43 radio clips, 43 TV clips and 74 print and online articles.

The coverage of ESTCube-1 in Estonian media is characterized by a steady visibility throughout the project and an uncritical tone. As shown on Figure 3, ESTCube-1 was reported in Estonian media regularly, the only quiet periods being mid-2009 until the end of 2010 (during the preparation phase of the project) and the second half of 2014 (during attempts to execute the experiment). During other periods, the team received at least one media interaction in each quarter of a year. These were mostly initiated by the team, either with a press release, an event or a direct contact with a journalist.

As indicated in the quote on page 58, the team initially used mainly press releases to contact media but then switched to events and direct contacts as more effective tools. Peaks in coverage were related to events (press conferences and the launch) while press releases associated with other project activities received little media interest: these led to up to three original media items but usually one or none. Later in the project, the team mostly used direct contacts to initiate media coverage and published press releases only after the contacted channel or publication had released the story (e.g., in August 2013 when the satellite had several close encounters with space junk the story was pitched to the main tabloid newspaper).

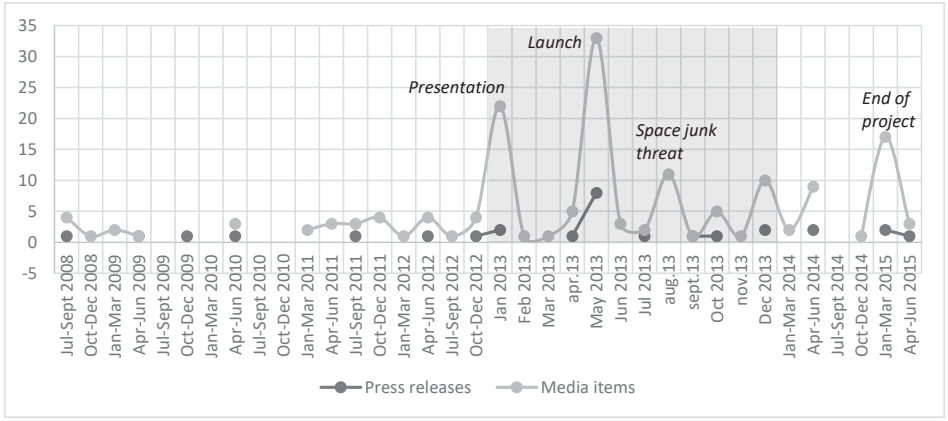

Figure 3. *Timeline of ESTCube press releases and media items (units on time-axis represent three-month sections, except for the launch year – 2013, on background – which is presented month by month) (Source: Article III)*

The coverage was concentrated to channels with most visibility and weight in the society, partly due to efforts of the team. Four channels - Estonia's Public Broadcasting main TV channel *ETV* and main radio channel *Vikerraadio*, the biggest daily *Postimees* and main commercial news-talk radio channel *Kuku* – accounted for more than half of the coverage. The number of journalists with multiple media items about the project is evidence of an established relationship between the team and journalists: there are seven authors (including myself) with at least five items.

Besides the quantitative aspects, the analysis also included a qualitative dimension, comparing the attributes presented in the team's press releases and media coverage. Text analysis resulted in ten attributes:

- *Organizational*, describing the current state of the project, organizational arrangements, and future steps;
- *Scientific*, explaining the nature of the E-sail and its potential use in future space exploration; other research results of the satellite;
- *Engineering*, explaining the building of the satellite, technical aspects and challenges of the project;
- *Educational*, highlighting the use and impact of the project as a study method;
- *Outreach*, describing the use of the project to promote STEM-subjects;
- *Co-operation*, with other universities or companies;
- *Societal impacts of the project*, such as economic benefits, national pride, etc.;
- *Outside reaction*, focusing on awards, recognition, or critique;

- *Personal*, introducing people in the project;
- *Other related topics*, such as spin-off companies, photo contest, etc. (**Article III**)

As shown on Figure 4, the press releases presented the main aspects of the project fairly equally, while media had a clear focus on reporting the progress of the project. Media attention to the *scientific* and *engineering* attributes can also be well understood. The *educational* attribute is second most prominent in press releases and also features in every fifth media item.

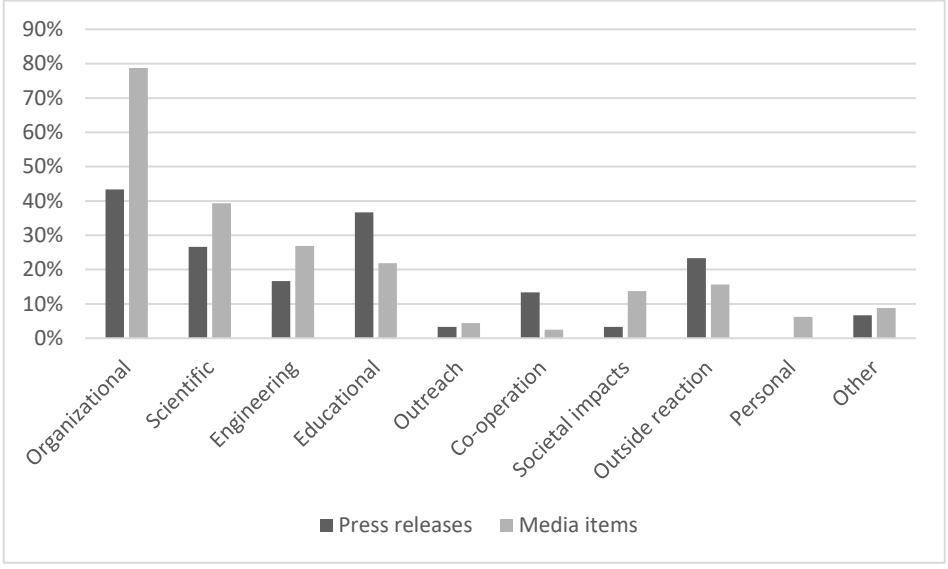

Figure 4. *Percentage of press releases and media items with identified attributes. (Source: Article III)*

A rhetorical analysis of the media texts, especially the (live TV and radio) interviews given by the team members helps to see behind the statistics. The questions by the journalists tend to address organizational, scientific or engineering aspects of the projects whereas the team members used opportunities to insert the *educational* and *impact to the society* attributes to the conversation. This is a typical example from a TV breakfast show:

> *Host: "What is the mission of the satellite?"*
>
> *Project supervisor: "To support Estonia's economy and support Estonia's reputation as a country capable of developing high-tech. This is the most important mission. But in the scientific sense [the mission is] to test components of the electric solar sail."* (ETV Terevisioon, 21.02.2013)

Journalists did not always follow up on these attributes but some of them adopted the framing and started presenting the *educational* and *societal impact* attributes as core features of the satellite project. For example, these aspects featured prominently in the media coverage when the project supervisor Mart Noorma was declared Person of the Year 2013 by *Postimees* newspaper. Also, the attributes were noticeable during the coverage of the final press conference at the end of the project.

At the press conference, when announcing the end of the mission and the results of the project, the team revealed that they had not been able to conduct the main scientific experiment of the mission due to malfunction of a component. At the same time, they declared the project to have been very successful because of the societal and educational achievements. These were presented as the main outcome of the project. Although much of the previous media coverage had been built around the e-sail experiment, the journalists accepted the reframing and reported the overall success of the project.

As shown earlier, the final press conference was preceded by a longer gap in media coverage. During the time, there was media interest in the experiment results, a "friendly pressure" (Interview E1) from the journalists to give them updates, the team admits. However, they chose not to share the results with the journalists, ensuring that no media reports were released during this period. Waiting with the release of the experiment results until the final press conference allowed them to balance the negative news (failure of the experiment) with positive messages (general success of the project), emphasizing the latter more strongly. The resulting media coverage continued the positive and supporting tone that was characteristic to the whole media discourse of ESTCube-1.

Next to the careful framing of messages by the team, the positive discourse was strongly supported by the composition of voices. Media coverage included almost no actors that were not affiliated with the project. Consequently, almost all quoted sources in media items expressed their support for the satellite team. The few cautiously critical notes that disputed some of the team's claims of success were presented at the end of the project by two experienced journalists but these did not receive a response in the following media coverage, possibly an indication on how strongly the success framing had established itself.

Combining the media coverage analysis with results from the interviews and my personal experience with the project, we have many reasons to suggest that the mediatized behavior patterns by the project team members played a significant role in achieving the constant and positive media coverage. The lack of independent voices or uncritical acceptance of the attributes offered by the team indicates that a mediatized interaction has the ability to interfere with norms and values of (science) journalism given the right conditions.

4. DISCUSSION

"As in natural selection, a special species of scientist, a small group within the scientific community, has evolved which is "fittest" to the media," Goodell (1977, p. 18) observed in her book *The Visible Scientists*, describing what we can now recognize as micro-level mediatization of science. Her sample was a small group of celebrity scientists whom she considers "mavericks" and an "anomaly", motivated to gain publicity mainly through the "practical need to foster funding, and an ideological commitment to social issues" (Goodell, 1977, p. 49).

"[T]oday's scientific stars are joined by thousands of others" who are keen to spread the excitement for science and regularly engage in science communication activities, as Gregory and Miller (2000, p. 221) note when describing the expansion of the field after science communication became more in demand and framed as a responsibility of every researcher. Among this group, too, we can witness scientists evolving towards being 'fit for the media' (i.e., mediatizing), as a response to more frequent exposure to communicating via mass media. The motivations for this group are also "often – consciously or inadvertently – multipurpose: while genuinely wishing to be informative or entertaining, scientists may also be popularizing science with the aim of promoting their area . . . in order to recruit students, and in the hope that funding may be maintained or even increased" (Gregory & Miller, 2000, p. 221).

Deeper insights into what shapes the relationship or scientists with media and the related perceptions and practices, and what drives the changes in these – in short, what are the patterns of mediatization – can both help to better explain certain characteristics of science reporting in media and help to evaluate and design activities which prepare researchers for public communication.

To better understand the connections between science communication and the mediatization processes, this thesis seeks and analyzes mediatization of science taking place:

a) **on the micro-level**. While the influence of research organizations on science reporting in the media has grown substantially (as is evident, for example, by the role of press releases in influencing media content), interaction between journalists and scientists remains a key arena in which coverage is shaped and where the logics of both fields come into direct contact. Therefore, this is also the place wherein "new patterns of social interaction" (Hjarvard, 2014) start to emerge once either side begins to negotiate the logics and adopt new interaction practices. The prevalent framing of science communication as the responsibility of every scientist also delegates such interactions, including with journalists, to the micro-level and assumes relevant individual skills and motivation. The visible scientists featured in this study, indeed, managed media interactions largely independently from their organizations, thereby indicating that the individual-level pressures and adaptations are a distinct phenomenon deserving to be studied in the context of mediatization.

b) **in a 'normal' or routine setting**, in contrast to the crisis mode of science-media interactions. Crisis, as defined by Bucchi (1996) and Rödder and Schäfer (2010), is a short period of extensive media coverage where science loses its agenda-building authority. Usually, a crisis is triggered by an extraordinary science event or external actors questioning the legitimacy of science. The main science-related content in media, on the other hand, consists of explanations of research results, updates on ongoing projects and the use of scientists as public experts. Scientists interacting with journalists in such situations, no matter who initiates the interaction, can be considered to be the normal setting in science communication in media. The coverage of ESTCube-1, although it was not a standard research project, is characteristic of the routine communication mode, rather than crisis mode, as the results show that researchers remained in control of the media agenda.

Previous studies that described indications of mediatization in science mostly identified these in crisis situations or as adaptations on the institutional level. Therefore, the description and characterization of interaction patterns on the micro-level and in a routine setting broadens our understanding of how and why mediatization processes unfold.

The interaction between researchers and journalists is shaped by a number of forces. The see-saw model in Figure 5 attempts to map the main forces that influence the power dynamics between the actors. Both scientists and journalists experience and possess a number of forces that can either strengthen their position in the interaction or reduce it. The position of either actor on its own end and the balance of ends relative to one another is what determines the overall dynamics of the relationship. In principle, the actor with a stronger position also has more control over the agenda. This does not necessarily imply a zero-sum nature of the interaction (except in extreme examples) and various positions of the see-saw can still indicate mutually beneficial relationships.

Of the listed forces, this thesis focuses on adaptations with media logic as the mechanism for non-media actors to strengthen their position on the see-saw. All groups interviewed for this study displayed some kind of adaptions to media logic, for example, adjusting the explanation style, using simplifications, preparing visual materials, considering news values, accepting journalistic routines or increasing the media's access to scientists. In short, making efforts to make reporting "easy for the journalist".

These adaptions are often presented by the researchers themselves as a response to the perceived flaws of media, such as lack of science content and issues with accuracy and distorted interpretation. In that perspective, adaptions function as tactical mediatization (Sawchuk, 2013), a response to a sense of lost agency and control. However, the patterns of interactions crafted by these adaptions also enable a stronger exertion of control. The interview results do show evidence of a strategic approach to science communication (Besley, 2020; Kessler et al., 2022), conscious

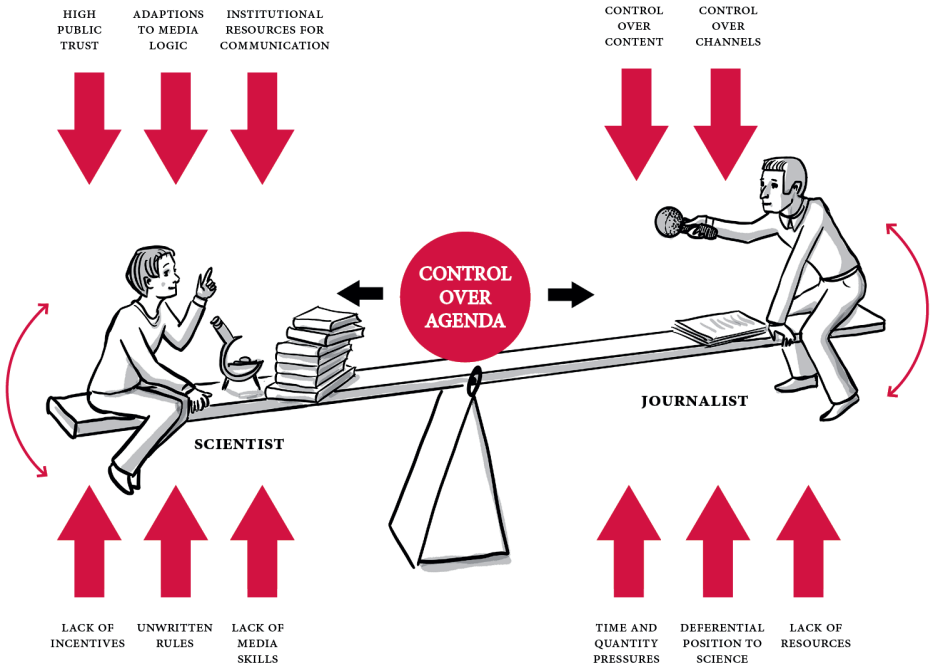

Figure 5. *A see-saw model of the forces shaping scientist-journalist interactions. (Illustration by Piret Räni)*

application of media logic to control the media agenda and accomplish certain strategic aims of the individual or organization.

Generally, the results support the model of "mental mediatization" (Marcinkowski, 2014) according to which the changes in interaction patterns are initiated by the stakeholders themselves as they perceive the benefits of media visibility. Although seeking public visibility is not self-evident in science (Weingart, 2022), some researchers have made conscious efforts to increase their personal visibility, visibility of their institution or general public visibility of science and have clear expectations of the benefits that this visibility will grant. Among the Estonian researchers, we see the science communication agenda in a prominent position as the expected outcome, i.e., increasing public awareness of and trust for science, and improvement of the public image of science. But we also see the multipurpose nature of their communication that was described by Gregory and Miller (2000) – another set of motives include attracting students, influencing the decision-makers to increase science funding or seeking new collaborations.

To understand mediatization, adaptions cannot be uncoupled from motives. The reasons one engages in science communication (via media) can be seen to shape their respective practices, including the types and extent of adaptions they are willing to make. Both motives and adaption are, in turn, rooted in the perceptions that the

individual has about the world: not just about media logic and media impact, that are highlighted in the mental mediatization approach, but also about science's role in society and the individual's capabilities of making an impact (Besley, Dudo, & Yuan, 2018).

Taking these factors into account will help to better notice and understand the variabilities of researchers' media interactions. As a result, we will find micro-level mediatization emerging as a spectrum phenomenon, composed of a series of functional niches that require a different extent, or intensity, of adaptions. There is a niche for the celebrity scientists and there is a niche for those who find it functional to deploy defensive mediatization strategies (Scheu, 2019). The intermittent space hosts those who are just happy to explain their science, researchers with strategic approaches and many others.

The thesis offers a set of indicators that enable mapping this space. The indicators are empirically derived and include both mental perceptions and self-reported media practices; each indicator can reflect a broad range of specific adaptions. Indicator analysis offers insights into variability in mediatization patterns that was visible even within the small sample of scientists who were interviewed for this thesis.

While the indicators do not address the question of the functionalities of the mediatization niches, the interviews provide some clues about how the intensity of mediatization is connected to aims and motives of the individual. Media visibility can be triggered by position (e.g., people elected to managerial position will start representing their institution in the media), journalist initiative (e.g., exploiting the explaining skills of a researcher) or other external factors such as the dissemination requirement by a funding organization, which tends to result – as judged by the Estonian sample – in less intense mediatization. At the same time, the extensive form of mediatization, which I have labeled *adopting media logic*, strongly associates with internal factors: having a clear strategic aim and a perception that media visibility allows to achieve this aim, resulting in a proactive and purposeful use of media interactions. These results indicate the role of scientists' strategic motivations in their communication activities as an important avenue for further study.

Given the prominence of the role of universities in current mediatization debates, one needs to look at the relationship between the individual and institutional dimensions in the mediatization of scientists. Article I of this study confirms that universities make adaptions to increase the public visibility, referring to the need to increase societal impact, legitimize themselves for the public and the political decision-makers, attract students and funding, and strengthen their position in competition with other universities in general. They perceive the role of their employees as important and expect them to contribute with individual and institutional visibility. However, in the interviews with researchers, the role of their institution in supporting their media activities was not explicit. The researchers considered themselves autonomous in their motivation and media practices and only rarely mentioned any collaboration with or support from the university's other units.

I acknowledge that the sample of the study is too small and biased to allow any conclusions about the flow of media-related adaptions between the individual and organizational levels. Besides universities' affinity to media, we know from previous research that press officers can be valuable partners to scientists in planning and conducting public communication (Koivumäki, 2021). The results of this study show us the crystallization of mediatization hallmarks within one research group, the ESTCube team, initiated and strongly facilitated by the group leader, as well as the presence of visible researchers who are considered role-models for the scientific community in Estonia. But despite these potentialities, the study results do not reveal any obvious examples of adaptions being triggered across levels in the organization, neither in top-down nor bottom-up direction. As mentioned, this could be due to sample characteristics or research scope that was unable to detect more subtle, indirect and informal impacts and influences between the levels. Both supportive and restrictive influences may be hidden. For example, it may be that the researchers with already established media practices are more immune to organizational level expectations. It may also be that researchers share organizational communication motives to the extent that they have internalized these and do not expose organizational expectations as a source of their adaptions. All this indicates that the links between micro- and meso-level mediatization, the mutual triggers and adaption transfer mechanisms still need to be demonstrated and conceptualized, both empirically and theoretically.

It is clear, however, that from the perspective of science communication, micro-level mediatization is a distinct trend with the power to significantly shape how science is represented in media. As the see-saw model implies, adaptions to media logic give the sources more control in interactions with the journalists, especially if coupled with factors that weaken the position of journalists, such as time-limited work routines or a deferential view of science. Such changes in media have been seen as one of the enablers for the strengthening of science PR which, as it is the most visible consequence, has led to a proliferation of institutional press releases (Autzen, 2014; Vogler & Schäfer, 2020). In Estonia, this general weakening of journalistic systems has been somewhat compensated by the establishment and expansion of science reporting teams in major media channels and outlets. Still, it is evident from the results of this thesis that the most extensive forms of micro-level mediatization where researchers adopt the principles of media logic may have an equivalent effect to institutional science PR, substantially enhancing the ability of researchers to insert the desired topics and framing into the media coverage. The indications that scientists have adopted their media practices in part to exploit the weakened position of journalists, further corroborates Goodell's argument that the characteristics of media are tightly connected with the characteristics of scientists visible in media.

Mediatization of the research group played a role in the coverage of the ESTCube-1 satellite. As science coverage in Estonian media tends to be supportive and non-critical, one cannot claim that the ESTCube coverage was qualitatively exceptional.

Nevertheless, the quantity of original media items and ability to consistently insert legitimizing angles to media items reflect the capabilities of the strategic media approach in shaping coverage.

Meanwhile, new or crystallized patterns of interactions with journalists that make scientists more readily available to journalists or increase their abilities to communicate science in a way that supports the public's knowledge about and interest in science are in line with many aims of science communication. One can also argue that individual level agency may help to reduce the potency of organization level PR.

Therefore, the impacts of mediatization processes on science communication are manifold and depend mainly on the motives of the actors. Those functional niches on the mediatization spectrum fit with different roles that the researcher can take (e.g., critic, explainer, advocate, administrator) but can vary in the extent to which they benefit the scientific endeavor, the institutions, the researchers, the journalists or the public. While much attention has been paid to the potential negative consequences of mediatization, this thesis brings forth the possibilities of mediatization patterns among scientists that can benefit public interest and support effective science communication. This, however, requires that journalists adapt to the adaptions of researchers playing their own game just as well the journalists themselves. The science communication ideal, therefore, could be a combination of a scientist who understands media and the public(s), and a responsible journalist working together to improve a meaningful societal dialogue about science and technology. Critical science journalism will be a necessary component in this.

Conceptualizing micro-level mediatization as a smorgasbord of functional adaptions to media logic presents a view of mediatization that sees the phenomenon fluid rather than fixed. A media-skilled researcher, depending on the topic or situation, may adopt different roles in media interactions and deploy different adaptions. As a result, s/he can move back and forth between the niches and even the levels (Weingart, 2012) and phases (Strömback, 2008) of mediatization. Whereas institutional level approaches tend to understand mediatization as an externally driven pervasive and invasive process, influencing all aspects of scientific endeavor and overriding certain core values, the micro-level fluid approach sees mediatization triggered by internal motives, leading to more agency regarding the adaptions. We could call this *toolbox mediatization*. What distinguishes it from a media skill set is the underlying understanding of the power of media visibility as the driver of adaptions. In this framework, the adaptions are not necessarily limited to media-effective adaptions but can also include defensive or counterproductive adaptions, if based on a certain perception of media logic. The impact of those adaptions on other aspects of scientific activity is possible but not necessarily a determined path.

For anyone involved in designing and conducting training sessions for scientists, the thesis should offer an opportunity to reflect on the question: What kind of communicators do we as a science communication community want our scientists

to be? That is, what kind of adaptions does the training initiate and support and for what kind of media roles are we preparing the scientists? Both a failure to adjust the communication approach to a specific audience and context (i.e., select the appropriate role and mediatization niche) or triggering adaptions that substantially weaken the autonomy of media may undermine the societal function of science communication. These questions become more relevant as the impact paradigm takes hold in research policy. Public communication is an important tool for achieving societal impact, providing a strong incentive for individual researchers and research institutions to seek visibility. Koivumäki and Wilkinson (2020) emphasize the role of academic leaders in supporting such a mindset towards communication in an organization.

When discussing the validity of the proposed mediatization framework in the context of other countries, one must start by considering the science and media systems of the respective country. Mediatization, per definition, is created in the interplay of the media logic(s) with that of a different societal institution and, thus, is predominantly shaped by the key characteristics of science and media systems. Therefore, the main conclusions of this thesis are expected to be valid in countries that are integrated in the international research community and have a high level of media freedom.

Next to the universal features that make possible mediatization as described in this thesis, are structural factors that impact the intensity of mediatization processes. For example, Article I brings out competition within science systems as a driver for mediatization. The pressures to communicate, existing incentives and barriers for public communication, and the professional level of science journalism can be additional components that shape the predominant mediatization patterns in different countries. All these, however, can be dissected with the same tools as used in this thesis to identify the mediatization patterns among Estonian scientists, thereby adding potential for country comparisons instead of producing isolated case studies.

In summary, this thesis contributes to mediatization research by advancing the conceptualization of micro-level mediatization and to science communication research by suggesting a more nuanced understanding of public visibility and the mechanisms underlying the different types of media visibility. The thesis contributes to the ongoing discussion about strategic science communication and the role of public relations in science. I discussed possible impacts of mediatization to science and science communication but am fully aware that the limitations of this research have only allowed a restricted view on the multitude of ongoing processes. The in-depth qualitative approach limited the sample size. The resulting focus on visible scientists revealed telling mediatization patterns but it can be assumed that inclusion of researchers with a wider range of media interaction patterns would have added a range of adaptions relevant for science communication.

Also, this thesis has relied on self-reported attitudes and practices when describing the impacts of mediatization. Analysis of media content (Article III) provides

indirect support to some of the proposed impacts but does not allow claiming causal relationships between the characteristics of media content and changes in researchers' media practices. Insights from other involved actors and additional methods would be necessary to provide evidence for how the practices are institutionalized.

Finally, although prominent and impactful, mediatization is just one of many processes that shape how scientists interact with society. The ESTCube example shows, for example, how science communication can be driven by the adoption of new education practices such as problem-based learning. It was beyond the scope of this thesis to chart the complex interactions of various societal processes with mediatization beyond what was immediately visible from the interviews.

4.1 DIRECTIONS FOR FURTHER RESEARCH

All these limitations point to relevant directions for further research. In science communication, it might be useful to catalogue and dissect the various roles that scientists fulfill in public communication (as a good example, Moorhead et al., 2023 has started to expand the typology proposed in this thesis). Understanding the way that various motives and relevant adaptions lead to functional roles and shape interaction patterns with other societal institutions can be helpful for designing and improving science communication not just in media but also other formats (social media, public presentations, engagement activities etc.).

For this purpose, we also need a better understanding of the communication practices, objectives and adaptions of a wider group of scientists than just those frequently visible in media – including those who are more modestly visible, those who fail to gain media attention despite attempts and those who avoid visibility. The way they respond to the institutional and societal pressures for public communication and visibility can reveal further functional and dysfunctional adaptions. The other side, journalists, also deserve further attention and research into how they deal with mediatized sources.

Additionally, links between micro- and meso-level mediatization need to be demonstrated, differences and similarities in mediatization patterns during crisis situations (such as the COVID-19 pandemic) and normal circumstances could be explored, and the question tackled whether the social sciences and humanities have distinct patterns of mediatization in comparison to representatives of natural sciences and engineering.

This thesis pays little attention to social media, mostly because it was not highlighted as a relevant channel for those visible scientists interviewed for the study. Today, the importance of social media in public engagement cannot be overlooked, therefore this thesis could inspire an investigation whether and how social media practices of scientists are shaped by similar push and pull factors and adaptions to social media logic.

5. CONCLUSION

The thesis had three research questions which will be answered in the following section.

1) What elements facilitated the mediatization process of the investigated researchers?

In the case of ESTCube-1, as I was able conclude both from the research interviews and by reflecting on my personal contributions to the group's communication mindset, the development of media skills among the involved young researchers was strongly supported by project leadership, participation in media training workshops and regular collective reflections on media interactions. The combination of these three factors led to changes in attitudes and practices in a way that can be considered intense mediatization; considerations about media visibility occupy a central role in this process. Media visibility, therefore, is perceived as valuable for various reasons, from educating the public to gaining strategic advantage (individual and institutional goals that lead to mediatization on both levels may overlap but this thesis demonstrates that mediatization processes may also run independently on the micro-level). Among the interviewed researchers, a group emerged for whom the mediatization process was triggered by personal motivation related to some strategic aim, usually leading to more profound changes in attitudes and practices. Later, media visibility of these scientists can be sustained by media interest (i.e., they have become an established source for the media). The data indicated other pathways to media visibility, or mediatization with just one or two of the identified factors, but with a less intense outcome.

2) What indicators can be used to describe the mediatization characteristics of individual scientists?

The thesis proposes five dimensions in which the relationship of the scientists to media logic and the related media attitudes and practices produce functional differences: Communication as a responsibility; Awareness of media logic; Mastering media logic; Purposeful use of media; Institutionalization of communication activities. These dimensions produce qualitative indicators (see Table 6, p. 65) that are used to characterize typical patterns of mediatization. Besides evaluating the intensity of mediatization, these patterns, I argue, describe functional niches in the science-media ecosystem that scientists can occupy. Different goals require different adaptions to media logic, leading to researchers taking different roles, each with their characteristic pattern of mediatization, captured with the help of the proposed indicators.

3) What impacts can be associated with the individual and collective media-related adaptions?

Mediatization has been mostly associated with a potential negative impact on science, e.g., by undermining its values or jeopardizing public trust when the promotional discourse becomes dominant. The respondents denied that they have observed such profound impacts and these were not immediately evident in the data either, possibly due to the focus of the thesis on the individual level and adaptions on the level of interactions. The described changes were predominantly perceived to be in line with the commitment to public communication and considered beneficial, both for the public and for the communicating individual or institution.

Next to changes on the interactional and institutional levels, there are indicators for potential changes on the program level, concerning what and how to study. ESTCube-type projects have been initiated in other universities (e.g., a student satellite and a self-driving car in Tallinn Technical University) and ESTCube-1 has been followed by ESTCube-2. There are likely several reasons for the increased initiation of such projects. While they are effective educational tools, their ability to attract media visibility, through which both research groups and institutions can achieve their strategic aims, cannot be denied.

Mediatization processes in science, when accompanied by other autonomy-reducing changes in media, can impact journalism's ability to report science in a critical way. The individual media skills of researchers can increase his/her ability to exploit media logic with the aims of maintaining visibility and inserting their agenda and framing into the media coverage of their work. This emphasizes the need for journalists who are aware and able to manage mediatized sources. The more skilled any stakeholder becomes, the more necessary it is for journalists to critically evaluate claims being presented to the public. While science generally has a positive agenda, malpractice or PR intentions cannot be excluded.

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PUBLICATIONS

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Scheu, A. M., **Olesk, A.** (2018). National Contextual Influences on Mediatization: The Comparison of Science Decision Makers in Estonia and Germany. *Science Communication*, 40 (3), 366−392. https://doi.org/10.1177/1075547018766917.

Research Article

Science Communication
2018, Vol. 40(3) 366–392

DOI: 10.1177/1075547018766917
journals.sagepub.com/home/scx

National Contextual Influences on Mediatization: The Comparison of Science Decision Makers in Estonia and Germany

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Abstract

The study investigates adaptations of organizations in the field of science to the requirements of mass media. Based on the current research, we assume that mediatization is advanced by the need of individual and collective actors for public attention and that this need varies depending on national structural factors. We compared Estonia and Germany where the science and media systems differ in their size and structure but have a similarly competitive funding environment. Our results demonstrate variability considering the intensity of reported implementations of media-related structural adaptations within organizations. These differences can be linked to country-specific structural factors.

Keywords

mediatization, decision makers, international comparison, Estonia, Germany, science communication

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Introduction

This article compares how decision makers in science perceive the mediatization of science organizations in Estonia and Germany and how they describe the influences and impacts of that process. In current (democratic) societies, public attention has become a relevant resource for actors in various social fields. Public attention is used to strengthen positions, to realize organizational goals, to influence decision making, or to secure their performance. What is more, public attention is a scarce resource (Franck, 1998), and it is safe to assume that developments in technology and media systems have increased the competition for public attention. In this setting, institutionalized mass media are especially relevant. The concept of mediatization therefore describes repercussions in various social fields, that are due to actors orienting toward the way mass media are generating public attention (Marcinkowski, 2014; Weingart, 2012).

The concept of mediatization allows for researching the long-term effects of increasing orientation toward public attention on the level of actions and structures. Classic public relations (PR) activities and the extension of PR structures and resources is an obvious example. The concept of mediatization, however, addresses developments far beyond the field of PR. Mediatization describes thorough changes of different organizational areas and structural contexts that are traditionally not related to PR as well as long-term effects of such changes. Changes in the course of mediatization might affect the constellation of actors (e.g., empowerment of marginal actors), structures of expectations (e.g., implementation of regulations that control access to media), and structures of interpretation (e.g., reputation management; see section "Mediatization").

Our aim is to compare Estonia and Germany and to empirically investigate influences on mediatization processes. Why do actors adapt to media logic and why are some actors promoting mediatization while others try to slow down adaptations? The comparative approach also deals with a gap in mediatization research (Marcinkowski & Steiner, 2010; Meyen, 2009; Neuberger, 2013; Reinemann, 2010). In this case, the comparison between the mediatization of science in Estonia and in Germany offers the possibility to compare external contextual influences on mediatization and thereby identify driving forces of mediatization. While the countries provide a similar science funding environment, they differ in contextual aspects such as size and structural characteristics of the political and the scientific fields as well as the mass media (see section "National Science Systems in Germany and Estonia").

In the best case, mediatization can help actors in science to reach their specific goals. In the worst-case scenario, mediatization may lead to heteronomy and might even endanger the functionality of the scientific field (cf. Marcinkowski & Kohring, 2014; Weingart, 2012). The latter case would also bear negative effects on society as a whole (e.g., loss of trust in scientific evidence, simplification and exaggeration of findings, neglect of basic research in favor of applied research that is promising intensive media coverage).

We argue that decision makers' perceptions about the shape of media logic can be considered the point of reference for media-related structural adaptations (Nölleke & Scheu, 2018). The nature of these adaptations is also dependent on the contextual influences. Because of the differing sizes and characteristics of science and media structures, we assume that the fields of science in Estonia and Germany vary with respect to their need for public attention and, hence, the intensity of mediatization. Empirically, the study is based on 26 semistructured in-depth interviews with Estonian (7) and German (19) (Vice-)Presidents (and people in comparable positions) within universities, nonuniversity research institutes, and funding organizations.

Theory

Mediatization describes the "appropriation of media logics by institutions and cultural practices" (Lunt & Livingstone, 2016, p. 5). The concept of mediatization addresses structural adaptations on the micro-level of individuals, the meso-level of organizations, and the macro-level of social systems (Marcinkowski, 2014). Concerning our study, mediatization applies to individual decision makers, scientific organizations (e.g., universities), and the scientific field as a whole and manifests itself as the "institutionalization of new patterns of social interaction" (Hjarvard, 2014, p. 202). Differentiation theory suggests that structural adaptations essentially serve to increase the performance of actors/social systems or to fend off external influences (Scheu, Volpers, Summ, & Blöbaum, 2014). In order to do so, actors adapt to what they perceive as mass media logic (Nölleke & Scheu, 2018). The present study uses the term *media logic* as discussed by Altheide and Snow (1979; Altheide, 2013). Adaptations in the course of mediatization serve to improve access to publicity (Marcinkowski & Steiner, 2010), and it is the journalistic mass media that primarily manage public discourses and generate public attention (Kohring, 2004).

We assume that mediatization concerns both actions and structures, with both levels determining and enabling each other reciprocally (Bourdieu, 1987; Giddens, 2008; Schimank, 2010). On the level of actions, mediatization

should lead to actors increasingly relying on journalistic mass media in order to observe and influence each other. Adaptations on the structural level enable actors to access services of journalistic mass media—that is, the service of providing public attention.

The level of structures can be divided analytically into constellations of actors, expectations, and interpretations (Schimank, 2007). In short, constellations of actors describe the relative positions of actors within the field, while structures of expectations consist of organizational structures, norms, roles, or institutions, and structures of interpretations integrate basic categories of perception and interpretation of social reality, as well as commonly accepted stocks of knowledge. The mediatization of science in Estonia and Germany can be investigated by considering this analytical differentiation. The mediatization of the constellations of actors regarding the field of science entails changes and shifts of the relative positions and power of relevant actors due to the logic of mass media publicity. Schulz (2006) found a shift in power in politics favoring prominent politicians and disadvantaging the party base. In the field of research policy, Scheu et al. (2014) found that decision makers perceive the empowerment of formerly rather irrelevant actors such as nongovernmental organizations (NGOs) or student organizations that use media attention to influence decision-making processes (for a similar finding considering the media policy constellation, see Wendelin & Löblich, 2013). The current study investigates such shifts from the perspective of decision makers in science organizations in Estonia and Germany. With the mediatization of structures of expectations we refer to mass media–related changes involving formal and informal norms (e.g., the norm to inform the general public), regulations (e.g., the obligation to obtain approval to do interviews with journalists), roles (e.g., the integration of media skills in the job profiles of decision makers), programs (e.g., the integration of demands for scientific communication by research funding organizations), institutions (e.g., the popularization of scientific journals), or the structure of organizations (e.g., the extension of PR departments). Finally, the mediatization of structures of interpretations means that organizations and individual actors adapt their objectives, motives, practical knowledge (cognitive orientation), or judgmental criteria (evaluative orientation) to the operative logic of journalism.

In sum, this study investigates decision makers' perceptions of the mediatization of science. We ask about perceived media logic, about the changing relevance of mass media–related actions within the scientific field, and about structural changes related to perceived media logic. In doing so, we consider the constellation of actors, structures of expectation, and structures of interpretation (see Table 1).

Table 1. Analytical Categories.

Main categories	Subcategories
Perceived media logic	• Operative routines of news production: research, production, selection, presentation • Individual actors in the field of news production: expertise, education, political attitudes • Organizations in the field of news production: external influences, organizational structures, internal influences (editorial decision-making processes, working conditions, political bias), technological constraints
Relevance of media-related actions	• Mutual observation via news media • Self-representation via news media • Publicity as a resource
Structural adaptations	• Constellation of actors: positions, institutionalized relations • Structures of expectations: organizational structures, (in-)formal norms, regulations, roles, operative routines • Structures of interpretations: objectives, motives, cognitive and evaluative orientations, media as point of reference

Our aim is to identify commonalities and differences between the scientific organizations in Estonia and Germany. The questions that guide our research are the following:

Research Question 1: How do science decision makers in Estonia and in Germany perceive media logic?
Research Question 2: How do science decision makers in Estonia and in Germany perceive the role of mass media for their work?
Research Question 3: How do science decision makers in Estonia and in Germany perceive the intensity of the mediatization of science, including structural changes toward media logic within science?

Hereby, we assume that the national context influences the perception of media logic (Research Question 1) and of the role of mass media in the science constellation (Research Question 2) as well as the intensity of mediatization (Research Question 3). Both countries are characterized by intense

competition between science organizations and uncertainty in the field of science due to the recent science policy developments. However, since the field of science (and media and political decision making) in Germany is larger than in Estonia, and therefore the mediation between the stakeholders provided by the mass media is more needed, we assume that the German decision makers reflect more thoroughly on the logic of the media, perceive a stronger need to accommodate to this logic, and also observe more intense adaptations within science and science organizations.

Research Design

Methodologically, we conducted semistructured in-depth interviews with Estonian (7) and German (19) (vice-)presidents (and people in comparable positions) within universities, nonuniversity research organizations, and funding organizations. We interviewed the respondents considering their roles as decision makers within organizations. The respondents can be regarded as experts on their organizations and organizational contexts; as experts, they provide data on organizational developments, structures, and structural changes (Blöbaum, Nölleke, & Scheu, 2016). Experts represent not their private views but perspectives that are typical for their professional contexts (Meuser & Nagel, 2009), and as such, they serve as empirical access to comparing organizational structural developments for this study.

We compared organizations in Estonia and Germany because the countries' science, policy, and media systems differ in their size and structure but have similar competitive funding environments. This offers the possibility to compare contextual influences on mediatization. What is more, the idea to compare mediatization in Estonia and Germany originates from discussions between the authors of the study who have been researching mediatization of science in their respective countries. The joint publication was realized during an EU-funded exchange program.

The study relies on the data from a research project funded by the German Federal Ministry of Education and Research (BMBF) gathered in 2012/2013 and additional interviews with Estonian science decision makers held in 2016. The Estonian study replicates the previous German study. This also leads to a 3-year time lag between the studies, which must be considered when comparing the findings. However, mediatization is a long-term process that can be considered to develop independently in both countries. What is more, the shared empirical concept of the studies allows for reflections of our subjects on long-term structural changes as well as general developments in science. We therefore argue that the results can be compared despite the disparate periods of data collection.

Table 2. Selection of Organizations and Interviewees.

	Estonia (7)	Germany (19)
Advisory boards	Academy of Sciences (1)	Council of Science and Humanities (1)
Funding	Head of the Estonian Research Council (1)	Heads of Departments of Federal Ministry of Education and Research (3), German Research Foundation (2), Volkswagenstiftung (2)
Universities	Presidents/vice-presidents of the University of Tartu (1), Tallinn University (1), Estonian University of Life Sciences (1), and Estonian Academy of Arts (1)	Presidents/vice-presidents of the Humboldt-University Berlin (1), the Johann Wolfgang Goethe-University Frankfurt am Main (1), the Georg-August-University Göttingen (1), the University of Hamburg (1), the Ilmenau University of Technology (1), the Karlsruhe Institute of Technology (1), the University of Köln (1), and the University of Münster (1)
Nonacademic research organizations	Director of the National Institute of Chemical Physics and Biophysics (1)	Board members/directors of the Helmholtz-Centre Potsdam—GFZ German Research Centre for Geosciences (1), the Leibniz Institute for Farm Animal Biology (1), and the Max-Planck-Institute for Meteorology (1)

In order to provide comparable data for Estonia and Germany, we translated the relevant questions from the originally German interview guidelines and used them in the interviews with Estonian decision makers. The interview guidelines included questions considering the analytical categories summarized in Table 1. The interview guidelines contained open questions that serve to structure the interviews and provide comparability of our data. The openness of the questions[1] also served the explorative aims of our study (Meyen, Löblich, Pfaff-Rüdiger, & Riesmeyer, 2011). The interviews are available transcripts in German and Estonian. The interview guidelines have been adapted to every interviewee individually using information about the organizations and interviewees available online.

The interviewees (see Table 2) were selected in two steps. First, we identified the most relevant organizations within the scientific fields in Estonia and in Germany. Second, we contacted the decision makers within the identified organizations. The interviewees are experts of their organizations and the respective national field of science. At the same time, the selected decision makers are also subjects of mediatization, that is, they are individual actors

that anticipate media logic and promote structural adaptations within their organizations.

The most important organizations in the context of this study are universities, nonacademic research organizations, and disciplinary associations. Additionally, we interviewed decision makers within science-policy advisory boards. The selection criterion for particular organizations has been their relative importance within the field, for example, their potential influence to the constellation of science and science policy. We also included the major funding organizations since they actively shape the field of research. Recent developments in Estonia and Germany—such as an increasing dependency of all science organizations on competitive allocation procedures—further strengthen the position of funding organizations within the national constellations.

All the interviewees are decision makers within the organizational structures of the selected organizations: (vice-)presidents, (vice-)directors, heads of departments, and/or board members. Semistructured interviews were conducted between May 2012 and March 2013 in Germany and between January and February 2016 in Estonia. The interviews were held either by phone or in person, and on average, they took approximately 40 minutes. The interviews were recorded, filed as mp3 files, as well as transcribed and edited for clarity. The interviews were then coded thematically, using Atlas.ti (Gibbs, 2013) for the German data and manual coding for the Estonian data. The process of data analysis involved both a deductive aspect and an inductive aspect (Reichertz, 2014). We applied the deductive logic to identify relevant citations within interview transcripts according to our systematization of the concept of mediatization (see Table 1; Mayring, 2008; Schreier, 2014). In other words, we coded passages within the interviews using the analytical categories summarized in Table 1. This was done separately for both data sets by the respective researchers and has been checked and validated discursively during the whole research process. Afterwards, we inductively interpreted the relevant text passages, and further differentiated, complemented, or merged our categories. For this, the citations were translated into English and then interpreted and compared by both authors. As the qualitative coding was completed earlier for the German data, the coding of the Estonian data was preceded by a discussion to ensure similar understanding of key coding elements. Any questions were solved by intercoder discussions. The comparison and identification of commonalities and differences between science decision makers in Estonia and Germany was conducted on the level of individual decision makers. The data were interpreted discursively by the research team (Cornish, Gillespie, & Zittoun, 2014).

Results

The comparison of interviews shows that national structural factors indeed seem to influence mediatization—that is, adaptations of actions and structures of organizations due to the perceived relevance of public attention and news media. In short, while our data suggest that national peculiarities do not influence the decision makers' evaluation of the relevance of mass media within their constellation, differences can be seen in the intensity of adaptations to media logic as well as in the assessment of these adaptations by the decision makers. Mass media is in both countries regarded as a resource to handle increased competition, to gain advantages over competing universities or research institutions, and to influence stakeholders from other social fields, most importantly politicians and policy makers. The decision makers in Germany and in Estonia assess similarly the rising relevance of mass media for their everyday work—for example, when considering the recruitment of new students or legitimizing costs vis-à-vis tax payers and politicians. At the same time, compared with the German respondents, the Estonian respondents report using media much less as a negotiation arena with other stakeholder groups, preferring direct contact. The Estonian respondents see the aim of mediatization in increasing both the public understanding of science and trust in science, and in supporting the positive image of organizations. Also, the German decision makers perceive potentially negative long-term effects of adaptations to media logic on the core processes of science organizations much more profoundly than their Estonian counterparts.

National Science Systems in Germany and Estonia

An obvious difference between Estonia and Germany is their size—Estonia is a relatively small nation (1.3 million inhabitants) compared with Germany (82 million inhabitants). Unsurprisingly, this is reflected in their science systems. In Estonia, research and development is conducted at universities in the two major cities: Tallinn and Tartu. Estonia has six public universities, the largest being the University of Tartu. In addition to the public universities, research is done in several small independent research institutions. Private research and development done by companies is not investigated in this article. In contrast, the German science and research system is much more diverse and decentralized. According to statistics by the *Federal Statistical Office*, since the winter term 2015/2016, there are 427[2] institutions of higher education spread all over Germany. This number includes 107 universities, 216 specialized colleges of higher education, and other colleges. Furthermore, research in Germany is characterized by strong and numerous nonacademic

research institutions attached to the four big German nonacademic research organizations: Frauenhofer, Helmholtz Association, Leibniz Association, and Max Planck Society (Hohn, 2010). The field of research is further complemented by various departmental research organizations associated with political ministries (Knie & Simon, 2010).

Research funding in both countries is highly competitive. In Estonia, project-based funding has been estimated to account for approximately 80% of the total research funding (Raudla, Karo, Kattel, & Valdmaa, 2014) of which a significant part comes from various EU funds. The main national instruments of public research funding are managed by the Estonian Research Council, which introduced a new funding scheme in 2012. The reform reduced the number of issued grants and increased the average grant award. At the same time, the total funds allocated for public research funding did not increase and the proportion of research funding in GDP has been decreasing since 2011 (Koppel, Reimand, Raud, & Jaanson, 2016). This initiated a public discussion about the principles of science funding, including a joint public declaration by the Estonian Academy of Sciences, the Council of University Rectors, and the Estonian Science Foundation (see Villems, Kalm, & Koppel, 2014) and led to a series of policy decisions in 2015 and 2016 to address the issue.

In Germany, the DFG is the most important science funding organization for universities, accounting for about 30% of external funding, followed closely by industrial funding. About 20% of funding is contributed by federal institutions, most importantly by the Federal Ministry of Education and Research, and about 10% of university funds are raised from the EU (Hinze, 2010). In recent years, the financial situation of universities has become increasingly volatile, because the ratio of basic funds to third-party funding is shifting toward third-party funding (Hinze, 2010). Critics diagnose a chronical underfinancing of German universities (Knie & Simon, 2010). Moreover, the science systems in both countries have been and still are subject to reforms including the processes of standardization (keywords: Bologna Process, European Higher Education Area), the changeover to a Bachelor/Master structure, the implementation of (external) evaluation, and incentive funding (cf. Auranen & Nieminen, 2010; Schimank, 2005). Policy makers thereby intend to increase the efficiency, competitiveness, and relevance of scientific institutions.

Access to mass media, and therefore mediatization, should gain importance in competitive and volatile settings. Actors (organizations as well as individuals) in constellations that are highly competitive and/or are undergoing structural changes with open-ended effects on their organizations should feel a stronger urge to mediatize in order to get access to media publicity and influence the processes.

The Perception of Media Logic

The analysis of the interview transcripts suggests that the perception of media logic of our interviewees is above all characterized by commonalities. The respondents emphasize the crucial role of professional journalism for the generation of public attention and the reaching of relevant stakeholders in other social fields. This leads all our respondents to emphasizing the mechanics and characteristics of journalistic media outlets when reflecting on media logic.

When taking a closer look at the perceptions of media logic, it becomes clear that the respondents reflect on the operative routines of news media, in particular. To some extent, the respondents comment on aspects of research and production, but their focus lies on the processes of news selection and presentation. Above all, the respondents in both Germany and Estonia refer to news values such as negativity, conflict, competition, personalization, or controversy—"yellow" news, as characterized by several Estonian respondents. Such characteristics, in the perspective of our respondents, serve to increase public attention and influence the selection of issues. A university president in Germany states, "Journalists need drama; they have to tell a story." This tendency also applies to the coverage of scientific research, and media seems to be interested in "man-bites-dog stories" (manager of research funding organization, Germany). A vice-president of an Estonian university adds the human-interest aspect:

> [Media is interested in] positive events where we are dealing with something completely new. Then in things that humans have great interests in. This might not be a great scientific achievement but when it touches something that people care about—their pets, or nutrition or food, or our nature—then these things go really well. And from the negative side, all kinds of mishaps, scandals, discords and troubles get picked up really quickly. But a regular good working life is not possible to sell to journalists.

Further common criteria are simplicity, visualization, and the narrative potential. In the opinion of our interviewees, comprehensive and simplistic summaries, as well as visual material, increase the prospects for publication. The respondents agree that the journalistic selection criteria disfavor complex issues from the fields of research and research policy. Yet they feel that these complex issues are highly relevant and important to the broader public.

The interviewees observe similar trends concerning the presentation of information in the media. They feel that most media outlets scandalize issues, "Twisting everything around until it comes across as a sensation" (vice-president, disciplinary association, Germany) and are "hungry for gossip, shallow,

looking for effect, click-baiting." While no Estonian interviewee reports personal negative experiences such as their statements being twisted or misused, some of the German respondents also describe personal negative experiences.

The feeling that bias toward negative news values during selection processes is being intensified by certain routines of presentation featured more prominently among German respondents. In the respondents' view, media professionals highlight negative aspects of their stories, simplify some issues, and exaggerate others. The examples include media outlets contriving protagonists and antagonists, exaggerating conflicts, and dramatizing decision-making processes in order to raise the narrative potential of their stories.

When considering research and production, the respondents observe acceleration within media production processes:

> Time pressure leads to problems. Research intensity—particularly in online journalism—has decreased dramatically. The result is that articles get published that otherwise, taking quality as a benchmark, should never have been printed. (President, departmental research organization, Germany)

This entails the assessment that journalists—now more often than in the past—are forced to choose the path of the least resistance when working on an issue. "Sometimes the journalists have not done any background research, presenting just one person's story" (vice-president, university, Estonia). In the eyes of our interviewees, journalists increasingly tend to look for information that confirms their positions, consult with experts that are easily accessible, and use easily available research tools. The respondents adapt to this situation in order to compensate for the perceived loss of quality. An often-mentioned strategy is cultivating personal contacts with the media professionals whom they can trust, as a university president stated. In Estonia, such relationships enable decision makers in science to evade the problems they associate with the news selection. "Personally, I have three publications that, it seems, would unconditionally accept anything from me," an Estonian university vice-president says. One of his colleagues says, "I think that every institute [in our university] has one domesticated journalist that they can turn to when they have a story." These personal contacts allow the actors in science to ignore the tabloidization trends they perceive to dominate in the mainstream media. They work with "professional" and "competent" specialist journalists (such as opinion editors, science or cultural editors) and perceive less the need to adapt to media logic. Hence, the media interaction patterns in Estonia seem stable, whereas the German actors also perceive changes:

> Today, you don't cooperate with the same journalist over ten years anymore. Every two, three months you have to work with a new freelance journalist to

> whom you have to explain everything from the start. This means way more effort than before. (University president, Germany)

In sum, decision makers in science highlight the negative aspects of media logic. They seem to be disappointed about media hunting clicks, citing inadequate experts, simplifying scientific findings, and distorting information. A German university president summarizes her perspective: "They simply cut facts and report the facts wrong. This happens a lot." In Estonia, however, these processes are perceived not to affect the immediate interaction between media and research institutions. The respondents in Estonia perceive there is a section of media that remains little affected by the tabloidization trends. This allows the Estonian scientific actors to access the public via media without accommodating to the negative news selection and presentation criteria.

The Role of Media Publicity

All the interviewees agree that science and science policy issues gain importance, and they regard media publicity, that is, public visibility achieved through media presence, as a valuable resource for their everyday work. The decision makers in science organizations use media publicity in order to observe and influence each other. In this respect, the decision makers' self-reports correspond with the observations of science journalists (Knoop, 2013). Science journalists report increasing demands for science and science policy issues and argue that news media reports may have a (limited) impact on science policy decision making (Knoop, 2013).

Regarding the potential influence of news media reports within the science policy constellation, our respondents are relatively optimistic. They argue that by influencing the media agenda, it is possible to set issues on the science policy agenda—especially when gaining access to national quality media:

> I believe our politicians are to a large extent influenced by large daily newspapers . . . they mostly react to what is currently on the media agenda. (President of science funding organization, Estonia)

> When information about debates and proposals keeps coming, this puts a certain pressure on the government and the parliament, so they know that this is something they have to deal with. (University vice-president, Estonia)

> Some issues are pushed by the media, and politicians then have to act accordingly. (University president, Germany)

The science policy decision makers thus attach importance to media publicity within the science and science policy constellation. The reports of the interviewees suggest that the decision makers consciously acknowledge their own role within this constellation and analyze how the other stakeholders play theirs.

The Estonian and German respondents reflected on the ongoing science funding debates and discussed media's influence on the involved stakeholders. In summary, they see four functions for media publicity: a direct influence on decisions, the agenda setting, the public forum, and the cultivation of a positive image. Of these four functions, they perceive the direct influence to be the least common. However, there are differences between the actors from the two countries. While some German science decision makers indeed claim that they are able to use mass media to influence decisions and provide examples of past decisions that they have influenced, according to an Estonian director of a research institute, there is an "unwritten rule" that science policy is not made via media. The Estonian actors have access to the processes of decision making in science policy on the national level, and they argue that they primarily try to influence decisions via direct contacts. Therefore, the role of media in observing other actors also becomes less relevant compared with Germany. Media, however, is sometimes reported in Estonia to strengthen one's own negotiation position: "When [some messages] are transmitted only directly and personally, they do not have the same power as when they enter the public debate" (vice-president, University, Estonia).

Very similarly to the German respondents, the Estonian respondents describe as one of the main functions of media presence the cultivation of a positive image for the institution and for science in general. A flow of positive messages is believed to shape the public sentiment and influence decisions:

> All these [news items] generate a positive image [of the university] that helps funding decisions, creates a positive background for the parliament as the political decision-making body. (University president, Estonia)

Besides the political decision makers who control the general level of science funding, the target groups of the respondents in both countries include the general public ("We must convince the general public that science actually matters"—president of science funding organization, Estonia) and potential students ("When we want to have students, our university needs to be constantly visible"—university vice-president, Estonia). While the interviewees cannot give any specific examples of where such media presence has had an influence, they believe that media's impact is high.

Sometimes public visibility is even perceived as an existential matter in both countries:

> I believe that if our university would not be in the media, we would very soon cease to exist as a university. (University vice-president, Estonia)

> And today it is a fact that if you don't appear [in the media], you don't exist at all. (University president, Germany)

Therefore, it does not seem surprising that all the respondents develop strategies in order to use media publicity to their own advantage. They plan their communication activities in respect of journalism and mass media. Thus, on the one hand, the science decision makers have trust in conventional PR, conducted via institutional PR professionals. They emphasize the importance of being constantly visible through PR messages. On the other hand, respondents also stress the relevance of direct contacts with media professionals. The interviewees describe that cultivating relationships with journalists is of utmost importance.

> You have to initiate interviews with certain people you know. By interviews or other reports these journalists publish, you try to influence the representation of issues in the way that you want them to be represented. However, this is only possible by cultivating relationships to journalists—journalists, you know and appreciate. (University president, Germany)

These direct contacts also help the science policy decision makers to achieve what they perceive as the silver bullets to influence science policy decision making—guest editorials, comments, and interviews:

> We have had a couple of instances when we need to have a certain message published to gain a better position in negotiation with the minister. . . . The [newspaper] editors have agreed to publish it because they sense it is necessary. (President of Academy of Sciences, Estonia)

A university president in Germany also claims that in pushing certain research topics, journalists are influencing science funding organizations. The examples that our respondents list in this context are electro mobility, energy turnaround, or nanotechnology. The influence, however, can also be negative. The managing director of a German nonacademic research organization in the field of life sciences exemplifies such an influence: Issues like "the dioxin-scandal in Germany, fish stocks infested by worms or BSE," and the way the media report on such issues leads to "science policy representing a

cautious position toward funding research in these areas." The media publicity of these (and other) topics would influence political decisions and science funding. While politicians and science journalists acknowledge this form of media effects on science funding (cf. Knoop, 2013; Scheu et al., 2014), the interviewees representing science funding organizations neglect such influences.

In sum, the importance of journalism within the constellation is increasing—similarly to its increasing in other social fields (Marcinkowski & Steiner, 2010). The respondents claim that "networking within the press sector" (university vice-president, Germany) is very important, especially for people at higher levels of the hierarchy. Journalists are considered "critical, benevolent, investigative and educational companions" (university vice-president, Germany) of research policy processes as well as partners who can help advance one's aims and objectives. Therefore, the decision makers interviewed in the context of this study regard mass media and media publicity as an important resource in the constellation of science and science policy. They develop strategies in order to benefit from this resource.

The observed differences between Estonian and German actors can mainly be observed when considering the functions of publicity. Both see agenda setting and strengthening their position in negotiations as important goals achieved via media interactions. However, in Estonia the role of media as a tool to directly influence and observe other actors is less used. This is mostly due to the "small Estonia effect" (President of Academy of Sciences, Estonia) that enables direct access to other stakeholders. As a result, the Estonian respondents put more emphasis on indirect influences via the cultivation of a positive image.

Mediatization

Mediatization is described as a conscious process that, from the perspective of science decision makers, serves to increase the influence of science in negotiations with political stakeholders (see also Spörer-Wagner & Marcinkowski, 2010). As such, mediatization yields advantages over competitors and enables science decision makers to indirectly influence decision-making processes. These results overlap with PR research. In fact, what we describe as mediatization can often be related to PR activities as well as PR structures and resources. Nevertheless, our results suggest that it is important to differentiate between PR and mediatization. As we will show below, media orientation is thoroughly influencing the structural context of science organizations. Classic PR strategies and the extension of PR departments are just one aspect of mediatization. What is more, the course of mediatization changes organizational areas and

structural contexts that are traditionally not related to PR. For example, professional roles of decision makers within organizations adapt to media demands and now include tasks and competences related to PR. The decision makers in Estonia and Germany perceive adaptations considering the *constellation of actors*, the *structures of expectations*, as well as *the structures of interpretation*. It means that they attribute the influence of news media to the observed changes of the relative positions of actors, in the structures of organizations and the cognitive and evaluative orientations, or—to put it more clearly—to the need for publicity of organizations within the field of science.

The Mediatization of the Constellation of Actors. With regard to the constellation of actors within the field of science in Estonia and Germany, the respondents observe a slight shift in the positions of actors within the constellation. Even though the "classic" organizations are still being regarded as the most relevant players in the field, the mediatization of the constellation of actors primarily demonstrates that journalists and mass media outlets within the constellation are gaining importance.

The science decision makers—who traditionally are relatively dependent on political stakeholders—report that adaptations to media logic help enhance their position within the science policy constellation. This can take place not only on the level of single organizations but also in cooperation with several actors within the field, as the Estonian example reveals. "For several major issues [the universities] have made joint declarations that end up in the media," an Estonian university vice-president says. One of her colleagues suggests that a joint declaration by university presidents "got things moving" in the field of natural resources management. Similar statements are also provided by the German respondents.

Besides scientific organizations, other and especially rather marginal actors within the constellation are also perceived to benefit from mediatization, for example, NGOs, religious groups, or student organizations. In this context, the president of a German departmental research organization is not happy that instead of his organization, "an NGO with relatively few experts, who don't have the best reputation, gets cited one-to-one," and is thus able to influence public discourse and policy. "Loud stakeholders outbalance facts," as the president of the Estonian Academy of Sciences says.

Regarding the constellation of actors, it seems that less powerful and previously less influential actors particularly profit from mediatization and are thus able to improve their position within the constellation.

The Mediatization of the Structures of Expectations. Mediatization from the viewpoint of our respondents concerns above all adaptations regarding the

structures of expectations. Thus, interviewees claim that the ability to handle journalism and the media has become part of the role of the decision makers in science (see also Peters, Heinrichs, Jung, Kallfass, & Petersen, 2008). Such a view suggests that the respondents perceive an increase in the normative value of communicating science to the public and that they acknowledge this as part of the university's "third pillar" of serving the society (university vice-president, Estonia). Accordingly, scientists are now far more eager "to get their points across" (university president, Germany) and are better equipped for media interaction.

> By now, probably associated with a generation shift, we observe more and more conscious efforts from within the university to address the city, the state and the people. (University vice-president, Germany)

Regarding the adaptations of organizational structures, the interviewees report a professionalization of media relations connected to the extension of PR departments. However, the adaptations affect organizational structures more generally and also concerns the internal differentiation of organizations to help journalists quickly identify relevant experts within the organization in times of high media attention—when science-related public discourses occur (e.g., nanotechnology, the Arab spring, refugees) or even in cases of disasters such as earthquakes (see also Rödder & Schäfer, 2010). For example, the manager of a nonacademic research organization in Germany reports on the efforts to establish internal fields of competence, and Estonian universities have established a "list of spokespeople."

Mediatization also concerns internal workflows. The decision makers report that their organizations have established communication processes in order to "meet journalists halfway"—anticipating the demands of news media summarized in section "The Perception of Media Logic." This includes, for example, the simplification of complex issues and the production of clear, exciting, personalized, and visualized messages:

> Within our realms of possibility, we try everything to break down abstract and difficult [science policy] topics and to prepare and edit them for public reception (Member of German Council of Science and Humanities).

The respondents observe such adaptations regarding the way their organizations and they themselves communicate to the public. The perceived media logic (see section "The Perception of Media Logic") not only serves as point of reference while dealing with professional journalism but also when communicating via websites, social network sites, Twitter, or blogs.

The skills required for such communication are seen to be relevant on all levels of the organization, according to the Estonian respondents. For example, one university is considering introducing a career path that would allow employees to move from science to science communication, while another organization aims to equip specialist employees with communication skills:

> My dream is that at least all our heads of departments, and in the future, all senior specialists would be people with the qualification and capabilities to write generally understandable articles about their specialist subject. (Head of science funding organization, Estonia).

Another aspect of the mediatization of the structures of expectations lies in the establishment of formal and informal rules:

> I think every university would be well advised to establish an "information policy" or a communications strategy. I believe this is crucial, there just have to be some basic rules [considering media relations]. (University vice-president, Germany)

Such rules mostly aim at minimizing the negative effects of media coverage. The respondents do not want to "get caught in a trap set by professional journalists" (university vice-president, Germany) and have prepared "quick scenarios of how to behave" (university vice-president, Estonia). The respondents think that it is important that there are rules about who talks to the press. You have to prevent "everyone at once turning to the media" and instead ensure "that media activities are properly coordinated" (university president, Germany).

The interviewees also observe the limits of mediatization. Structural adaptations—as reported by the interviewees—only complement, extend, or protect the native functionality of organizations (see also Marcinkowski, 2005). The decision makers in science organizations claim that adaptations barely affect research; for science funding, decision makers state that funding decisions are not significantly affected by mediatization. However, a German example describes the adaptations of funding procedures:

> New funding programs can either be unimpressive or have a mobilization effect that is reflected in the mass media. . . . The "Exzellenzinitiative" [competitive national funding program in Germany] is reported in ordinary newspapers because it is connected to the idea of regional competition. . . . It triggers a kind of localism when different regions in Germany compete with each other.

The citation above refers to a conscious dramatization of allocation processes in accordance with the perception of media logic.

The Mediatization of the Structures of Interpretations. In this category, adaptations mostly concern cognitive orientations. The background knowledge about journalism is becoming increasingly important for science decision makers. In order to extend their knowledge, decision makers obtain information from scientific experts, ask internal media experts for advice, and organize practical media trainings and further education programs for executives and staff.

Adaptations of evaluative orientations are often linked to negative consequences (see Weingart, 2006). The respondents in this study, however, offer only little cause for contemplating such negative consequences. While the decision makers in funding organizations report that positive media coverage of funded research projects is regarded as an indicator of success, they also claim that this criterion is far less important for subsequent funding than other factors: "Even though some people might be able to convince the media that bad research is in fact good, it remains bad. And we don't fund bad research" (head of department of a funding organization, Germany). A member of the German Council of Science and Humanities confirms that "quality management is vital." The quality of science, from the perspective of our respondents, is still proven by scientific publications in highly ranked journals and not by media publicity.

However, it seems arguable whether such self-reports by the science decision makers are a valid instrument to investigate in-depth processes of mediatization concerning the structures of interpretations. It seems unlikely that decision makers will admit that they themselves or their organizations transform their core processes, motivations, and the main points of references—that is, their own operational logic—toward media logic. This doubt is backed by the fact that we found a third person effect regarding the decision makers' assessment of structural adaptations. The science decision makers describe far-reaching adaptations to media logic when talking about other actors, especially political actors. They also attribute to other actors or stakeholders mediatized actions such as "media campaigns" (university vice-president, Estonia) attempting to directly influence decision making, whereas one's own activities are rather described as having an influence via creating a favorable public background for science in general. However, the respondents strongly believe in the agenda-setting function of mass media: "Some issues are pushed by the media and politicians then have to act accordingly" (university president, Germany). Thus, politicians will start addressing problems related to science funding (Estonia) or shift the focuses of science funding. This finding is confirmed by a quantitative survey of decision makers at German universities (Marcinkowski, Kohring, Friedrichsmeier, & Fürst, 2013).

Potentially dysfunctional adaptations are observed by the science decision makers in Germany but hardly in Estonia. For example, a German university president complains that funding organizations do not necessarily support the most promising projects, but rather "put their money into 'sexy' [projects]. A fundamental question that arises is whether the appropriate incentives are in place." Examples of dysfunctional aspects can also be identified for universities and nonacademic research. According to the respondents, some scientists are also "black sheep" (university vice-president, Germany): they adjust their research far too much to the demands of mass media in order to get funding. The vice-president of a German university fears that "this trend rubs off on the field of science, leading to scientists trying to make their work look increasingly spectacular."

In Estonia, the respondents strongly focused on the positive aspects of mediatization and did not identify any major negative impacts that the adaptation processes might have on the organizations or science in general, other than "becoming just another entertainer among many others" (President of the Estonian Academy of Sciences).

Discussion

The concept of mediatization relates to long-term effects of increasing orientation toward public attention in different social fields and concerning various types of actors. The concept sheds light on changes considering the level of actions (e.g., role of media attention to influence decision making) well as structures (e.g., regulations, changing demands of professional roles, extension of PR departments). One important benefit of the concept therefore is that it allows for a broad perspective on mass media–related social change and offers a theoretical framework that enables interpretation of interrelations that usually are being discussed separately in communication studies.

This is one of the first studies to look comparatively at the intensity of mediatization in the field of science, and it offers a framework for further comparisons. We demonstrate in our study that the intensity of mediatization varies between countries and that those differences, in case of science decision makers, can be related to the characteristics of the national science policy constellation, and more generally, also to the characteristics of the science, policy, and media systems.

We consider the science policy fields both in Estonia and Germany as mediatized, indicated by the science decision makers' perception of media's importance and its growing role in the constellation of science policy actors. The interviews in both countries demonstrate that science decision makers consider the intensely competitive research environment

as the driving factor for media-related adaptations in research institutions. Those adaptions seek to exploit and expand the visibility provided by media and help explain the widening use of PR practices in the institutions as well as deeper visibility-related changes in professional roles and institutional structures.

Some of the differences between Germany and Estonia can be explained by the characteristics of the respective media structures. The German respondents refer to problems and risks relating to changes in the organizational structure of media houses (such as commercialization, increased competition, or the frequent use of freelancers). Both German and Estonian decision makers see media preferring negative news criteria such as scandals. However, the Estonian respondents have a much stronger sense of their communication being, to some extent, immune to these negative trends. The respondents from both countries report taking advantage of the specialist media and specialist journalists within general media to achieve visibility and reach relevant groups in science policy matters. In Estonia, these journalists seem to be more accessible to the science decision makers and decrease the need to adjust to "tabloid-press" trends; in Germany, decision makers perceive the need to carefully cultivate contacts with journalists over time.

Another contextual factor emerging from the interviews is the level of "entanglement" (university vice-president, Estonia) of science and society. Because of the differences in the population sizes, the Estonian stakeholders are much closer to each other than those in Germany. It is likely that the Estonian decision makers in the fields of science, policy, and media personally know each other or are easily accessible for direct contact. This changes the functions of media for them. When direct contacts are preferred, it becomes less relevant to observe other actors or to negotiate with them: The Estonian respondents see media rather as a tool to indirectly influence other societal actors via a steady stream of positive media messages.

This is a notable difference between the two countries when considering the intensity of mediatization. The universities and research institutions in both countries have undergone organizational changes in the form of expanding and strengthening the institution's PR offices. The German interviewees, however, perceive the impact of mediatization going much deeper into the scientific institutions with potentially dysfunctional consequences, for example, adaptations of research funding priorities to media logic. Whereas the German respondents reflect on the impacts of mediatization on the autonomy of scientific institutions, the ease of access to media that some Estonian respondents report would rather raise the question about the autonomy of journalism.

The interviewees indicate that the dysfunctional transformations within their own institution are prevented by the institutionalization of processes,

adaptations of the structures of expectations, and the extension of knowledge of mass media. Various regulations, the transformation of the organizational roles of the decision makers, the extension of PR departments, and other adaptations serve individual actors (Peters et al., 2013) to increase the positive potentials and to minimize the negative potentials of media publicity (Peters, Brossard, et al., 2008) as well as to immunize the core processes of organizations against external influences.

Our results indicate that country-specific structural factors must be considered when analyzing mediatization. As we assumed, the differences between the respective science systems help understand differences concerning decision makers' perceptions of media logic, their implementation of mass media in their everyday work, and the processes of mediatization. Moreover, differences regarding the respective media systems as well as the national science policy constellations must be considered. While the forces guiding the mediatization processes in various countries or societal fields can be similar, the specific characteristics and impacts of these processes are influenced by country-specific structural factors. Comparative studies are able to cast light on the variables and universalities of mediatization processes.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The study relies on the data from a research project funded by the German Federal Ministry of Education and Research (BMBF); grant number: 01UZ1006. The research received support by the European Social Fund in the framework of the DoRa programme, carried out by Archimedes Foundation.

Notes

1. For example, "What are your strategies for increasing public attention for your university?" or "What does a science-story need to get covered by media or liked on social media?"
2. https://www.destatis.de/EN/FactsFigures/SocietyState/EducationResearchCulture/InstitutionsHigherEducation/Tables/TypeInstitution.html

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Olesk, A. (2019). Mediatization of a Research Group: The Estonian Student Satellite ESTCube-1. *Science Communication*, 41 (2), 196−221. https://doi.org/10.1177/1075547018824102.

Research Article

Mediatization of a Research Group: The Estonian Student Satellite ESTCube-1

Science Communication
2019, Vol. 41(2) 196–221

DOI: 10.1177/1075547018824102
journals.sagepub.com/home/scx
SAGE

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Abstract

Increased interactions between researchers and the media can change the individual and collective practices in science due to the considerations about media logic. This article uses the example of the team behind the Estonian satellite ESTCube-1 to describe the process of mediatization and its impacts on the research project. The quick and extensive adaption to media logic by the team can be attributed to the interplay of three elements: the role of the group leader, participation in media trainings, and regular interactions with the media. This article provides a model of how micro-level mediatization is likely to take place in science.

Keywords

mediatization, science communication, media logic, media skills, qualitative research

Introduction

In science, the normative expectation for public communication has been dominant ever since the 1985 Royal Society report stated that "it is clearly a part of each scientist's professional responsibility to promote the public

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understanding of science" (The Royal Society, 1985). Following this, the requirement for public communication of science has been included in grant schemes and national and institutional policies. These measures have mostly been motivated by concern about the legitimacy of science in the public sphere, but other reasons have also been highlighted, such as influencing decision makers (Scheu, Volpers, Summ, & Blöbaum, 2014), securing funding (Väliverronen, 2001), and, as is the focus in the Estonian national science communication program, attracting students to study STEM (science, technology, engineering and mathematics) subjects (Estonian Research Council, n.d.). As a result, "the art of managing visibility is also becoming a daily routine for scientists," Väliverronen (2001, p. 27) has said.

Some of that increased visibility is achieved through organizational changes such as the strengthening of science public relations (PR) (e.g., Göpfert, 2007; Maeseele, 2013): Science organizations have established specialized communication units, become content producers, and thereby achieved significant influence on how the media cover their organization and activities (Peters et al., 2009). At the same time, scientists are also personally engaging in media interactions in different roles (Horst, 2013; Väliverronen, 2001), ranging from explaining their work to lobbying for a particular goal, and perceive a duty to talk to the media about their research as part of their professional role (Peters, 2013).

Compared with communication within the science community, operating in the demanding media environment can be expected to require different skills and practices from both the organizations and the individuals. The skills related to dissemination and media interactions are frequently the focus of communication trainings provided to researchers (Baram-Tsabari & Lewenstein, 2017; Besley, Dudo, Yuan, & Abi Ghannam, 2016; Miller & Fahy, 2009; Trench & Miller, 2012).

These trainings and other methods that increase media visibility are often seen as the tools to bridge the "gap" between science and the public and allow scientists more control over news content (Dudo, 2015), hence supporting the aims of science communication. However, some scholars, most notably Peter Weingart (2012), also point out that the adaptations that support visibility of science in our media-saturated society (Lundby, 2014) can also lead to changes in the ways in which how science as an institution operates. These adaptations and changes are conceptualized in the theory of mediatization, which this article will use to investigate the media interactions of the research group who devised and built the Estonian student satellite ESTCube-1. The group achieved substantial amount of public visibility and media attention during the course of the project (2008-2015) and is considered one of the greatest recent science communication success stories in Estonia. Beyond

their visibility, ESTCube-1 is a valuable case study for science communication and mediatization because the team started the project with no previous media experience, followed by a rapid transformation into a media-prominent research group. The fact that the process took place intensively within a well-defined time frame allows identifying and studying the factors that guided the process more precisely that it is usually possible. While there are a number of studies that have looked at factors that predict or support scientists' participation in public engagement including interactions with the media (e.g., Besley, Oh, & Nisbet, 2013; Dudo, 2013; Gascoigne & Metcalfe, 1997; Poliakoff & Webb, 2007) or the nature and perceived impact of communication trainings (e.g., Besley, Dudo, & Storksdieck, 2015; Miller & Fahy, 2009), there has been little research into how the process of acquiring media skills takes place in real-life situations. The example of ESTCube is able to shed light on this question.

The framework of mediatization, described in more detail below, adds to this the dimension of possible accompanying changes of the perceptions and practices of scientists, in response to their interactions with the media.

These aspects have defined the two main research questions guiding this study: (1) "How did the process of acquiring media skills unfold within the research group?" and (2) "What impacts did the process have on individual and collective practices of the team?"

These questions will be answered with a combination of qualitative interviews conducted with the satellite team members and the personal reflections of the author who had close interactions with the team during the project—in advisory, teaching, and journalism roles—and thereby had a firsthand influence on the mediatization process.

Mediatization

Mediatization is a concept that aims "to analyze critically the interrelation between changes in media and communications on the one hand, and changes in culture and society on the other" (Couldry & Hepp, 2013, p. 197). Mostly, research labelled as dealing with mediatization (also *medialization*) is describing the growing impact of media technologies and mass media systems in our societies, the dependence (Hjarvard, 2013) of culture and society on the media, and its possible effects. More precisely, this article follows the "institutionalist" perspective of mediatization that considers media as an autonomous social institution and focuses on the interactions of (mass) media with other social systems or institutions (e.g., politics, religion, or sports). There, "media logic"—or logics (Couldry, 2008)—becomes the central concept, defined most broadly as the form and formats of communication

(Altheide, 2013). Although criticized and difficult to formulate clearly, the term *media logic* is nevertheless widely used to conceptualize the distinctive practices of (journalistic news) media professionals that are being adopted by other actors or characteristics of media that lead institutions or individuals to accommodate (Schulz, 2004) to the way in which media operate. Plesner (2012, p. 680) suggests considering "media logic" a "collectively established construction, which we can research empirically by looking at how it makes a difference in practice."

The process of mediatization is driven not only by the pervasive logic(s) of media molding other social institutions but also, as, for example, Marcinkowski (2014) points out, by the desire of some of these institutions to increase their public visibility. The perceived urgency and nature of the problem that demands public visibility as part of its solution can thus help explain the different levels of mediatization across and within the institutions.

Mediatization can be analyzed on several levels. It has been described as a metatheory or metaprocess (Krotz & Hepp, 2011), but in the institutionalist perspective, most efforts are directed toward creating an understanding of mediatization on the meso-level, that is, mapping the multidimensional process of transformation of institutions (Hjarvard, 2013; Marcinkowski, 2014; Strömbäck, 2008), including their progression to the phase where the actions of institutional actors are governed by media logic, not their own institutional logic (Strömbäck, 2008). Additionally, micro-level studies "may look at particular practices of mediatization as performed and experienced by individual actors or small groups and how this may transform their life and work" (Lundby, 2014, p. 19).

To conceptualize mediatization on the micro-level, Marcinkowski (2014) proposes the model of "mental mediatization." According to this model, the experience of the omnipresence of the media triggers changes in the thinking, communicating, and acting of the individuals:

> Politicians experience at first-hand what powers of influence the media can exercise. This experience, coupled with frequent contact with journalists, the persuasions of media advisers and their own extensive media consumption, leads to the development of ideas about how media function. (pp. 17-18)

This allows us to understand (and investigate) mediatization as a phenomenon that is manifesting itself via the perceived understandings of media logic by individuals, and the influence of these perceptions on their actions. For example, the perception of what a journalist anticipates from a source can make the individual scientists or politicians adjust their formulations if they believe that this will grant them better visibility. The individual perceptions

can be studied qualitatively, common patterns can be identified, and the results linked to meso- and macro-level studies. The way in which individual media logic gets translated into the organization has been described by Pallas, Fredriksson, and Wedlin (2016).

Therein also lies the specific contribution of mediatization theory as it is able to bring together a whole range of changes to the same framework. Identifying the media-related motivations and perceptions helps explain various changes that individuals and organization undergo and undertake, ranging from perception of the role of various societal actors and the spread of PR-practices to the selection of research topic and methods. These adaptations can collectively be called mediatization.

Several studies on mediatization of science (Peters, 2013; Rödder, 2009; Rödder & Schäfer, 2010; Scheu et al., 2014) have given indications that scientific actors have a perception of a distinct media logic and have undertaken changes to accommodate to this logic. However, the arguments that significant shifts in science's relation to the public have taken place due to media influence are often based on extreme or nonroutine cases, Schäfer (2014) warns. Therefore, we are yet to understand the mechanisms of how adaptations to media logic might translate into changes in science, that is, how mediatization of science takes place in more common scientific settings. Active public communication via the media can be hypothesized to be a prerequisite and a catalyst for such deeper changes in science.

This article uses the framework proposed by Weingart (2012) to discuss various changes that can be considered manifestations of mediatization. He defines four levels on which changes can occur. The deepest level is the *system* level where changes in scientific criteria of novelty, relevance, and robustness would be replaced by the media's criteria of news values. Such a possibility he deems unlikely. Other levels are the following:

- *Program* level, for example, affecting the choice of theories and methods
- Level of *interaction*, for example, scientists communicating with journalists and creating potential for media prominence to be transformable into scientific reputation
- Level of *organization*, for example, hiring PR specialists at universities

As mediatization of science can be considered both a wanted (increase of public visibility of science and enhancing public understanding of science) and a hazardous (loss of science's autonomy, erosion of science's core values) process for science, it is important to study the push-and-pull forces that

scientists perceive to be guiding mediatization, as well as the resulting processes of adaption in order to better understand the undergoing changes.

The Estonian Student Satellite ESTCube-1

ESTCube-1 was a small satellite built following the CubeSat standards (Lätt et al., 2014). The project was announced in summer 2008 by a group of students from several Estonian universities, mostly from the University of Tartu. A year later, its scientific mission was selected: to deploy a component of a novel propulsion device, the electric solar sail, and to measure the E-sail force in orbit (Envall et al., 2014). The satellite was launched in May 2013, the main experiment was attempted in September 2014, but the deployment of the tether failed due to the malfunction of a component. The mission was concluded in February 2015, and in May, the same year, all contact with the satellite was lost.

ESTCube-1 was in many respects an unusual science project. The building of a satellite was initiated as part of the space technologies course in the University of Tartu without any prior in-house expertise (Slavinskis, Pajusalu, et al., 2015). The aim of the satellite project was as much educational as scientific (Slavinskis, Reinkubjas, et al., 2015): Problem-based learning allows a more practical and engaging learning process than classical lectures or seminars. As a result, the team composed of almost exclusively graduate and postgraduate students. The project did not have a stable source of funding. It started as an enthusiasm-led endeavor and was funded throughout by various smaller public grants. It required (and achieved) political support as the launch of the satellite, which would be Estonia's first, demanded changes in legislation and high-level international lobbying for a place onboard the European Space Agency's Vega launcher.

ESTCube-1 enjoyed substantial media attention throughout the project. The team issued 29 press releases, the number of original print articles, and TV and radio clips, both in Estonia and abroad, are more than 160, including one full-length documentary film. The project organized four well-attended press conferences: for the announcement of the scientific mission (2009), for the public presentation of the finalized satellite before launch (2013), on the 1-year anniversary of the launch (2014), and on the ending of the mission (2015). They had a dedicated web page and a Facebook page. The positive reception by the public and the media is reflected in several high recognitions such as Estonian Person of the Year 2013 title awarded by national newspaper *Postimees* (to the project supervisor) and Achievement of the Year by Estonian Public Broadcasting news website (also in 2013, selected by public vote).

An analysis of the press releases and media coverage on the ESTCube-1 project (Olesk, in press) showed that the team managed to set the media agenda: The media coverage was mostly driven by events organized by the project team, it lacked any critical or independent voices, and the media reproduced the framings presented to them. For example, the media also began to emphasize the educational nature of the project after this had been steadily highlighted by the team.

Method

The study is based on eight semistructured in-depth face-to-face interviews that were conducted with the project members between August 2014 and May 2015. The interview method was chosen for its ability to "generate interviewees' accounts of their own perspectives, perceptions, experiences, understandings, interpretations, and interactions" (Mason, 2004, p. 1021). Together, the interviews are used to tell a collective story, piecing together a theoretical narrative that has interpretive power (Charmaz & Belgrave, 2012).

Interviews were requested from the team members who had leading positions on the project (e.g., manager of a subsystem). All interviewees were male, aged 24 to 42 years at the time of the interview (see Table 1). All were PhD or MSc students at the time, except for the project supervisor who was an associate professor. The shortest interviews (5 and 6) lasted 36 and 24 minutes, respectively. The length of other interviews was 50 to 90 minutes. All interviews were conducted in Estonian, except for one (Interview 8) in English with a Latvian student. Except for one interviewee (Interview 4) who had been involved in popularizing astronomy, the other interviewees had very little previous media experience, limited to single instances of being interviewed for short news stories.

The interview included a series of open questions, which were structured into four main sections: media interactions during the project (including how these were initiated, how satisfied they were with the result and for what reasons), perceptions of media logic (including whether they understand such logic and are comfortable using it in media interactions), learning process (what helped them improve their media interactions), and media relations' impact on the project (including changes undertaken to improve the visibility of the team or its members). The interview design was primarily guided by the concept of media logic that is central to mediatization: Questions about media logic and descriptions of media interactions reveal how the team members understand the concept and perceive its effects on their practices, and questions about impact help map the changes, analyzed deductively from the interviews according to Weingart's (2012) model. Additionally, the question

Table 1. Interviewed ESTCube-1 Members.

Interview number	Role(s) in ESTCube-1	Age, years	No of media appearances during the project
1	Project supervisor	42	122
2	System architect, student supervisor	28	4
3	Project manager	34	20
4	Manager of communication subsystem	38	9
5	Manager of electrical subsystem, manager of attitude determination subsystem, systems engineer	30	8
6	Manager of battery subsystem, satellite integration, launch preparation	24	3
7	Manager of power subsystem, launch preparation	29	7
8	Manager of attitude determination and satellite control subsystem	27	3

about learning process was approached inductively by having the interviewees describe the important factors and events in their own words from which the main factors were inductively developed by a systematic examination of similarities within the case to develop concepts, ideas, or theories (Pascale, 2011). The coding of the interviews followed a two-step process: initial or open coding, followed by selective or focused coding (Charmaz & Belgrave, 2012).

Declaration of Author's Involvement

The formulation of the research questions and interview questions was strongly guided by the author's personal experience with and knowledge about the satellite project. For most of the project's duration, I was working full-time as a science journalist and was one of the first to do an in-depth story about the project (in 2008). The contacts with the group included informal discussions with the project supervisor about how to interact with the media. Between 2010 and 2012, I gave science communication workshops to young researchers in which several members of the ESTCube-1 team also participated. At the time, I was a strong supporter of ESTCube, wishing to contribute to its visibility and success. Its contribution to visibility of science

in Estonia is something I still value highly. My academic interest for the case began after starting my PhD in 2013 and learning about the concept of mediatization. This made evident that next to its success as inspiration to the public and other science communication strengths, the ESTCube project also entails questions about what impact this has to the way in which science is made. Despite the personal involvement, an autoethnographic study or practitioner-based inquiry would have been difficult to execute since data about my previous interactions with the team were not collected or documented in a scientific way as the relevance of certain (inter)actions for academic study was only apprehended in retrospect.

The article includes some paragraphs that reflect my personal accounts about my involvement in the mediatization process of the ESTCube team. On the one hand, this position of an "insider" who can also take on "outsider" attributes (Stanley, 2012) can be considered to be an asset for the study as it provides privileged access to the case. On the other, such personal accounts have the same limitations as every (auto)biographical writing, namely, that such knowledge is contextual, situational, and specific, Stanley (2012) adds. This means that the recollections can be affected by biases, selective memory, and errors, although, as a researcher, I have done my best to avoid such traps by using reflexive thinking.

My previous interactions with many of the interviewees (in the role of a journalist or media trainer) allow classifying the conducted interviews as "acquaintance interviews" (Garton & Copland, 2010). Authors who have discussed the impact of such relationships on data collection have tended to argue that it is helpful as it helps build trust and rapport, safeguards against "false" reporting, and allows access to resources that are not always available in more traditional social sciences interviews (Blichfeldt, 2007; Garton & Copland, 2010). However, as some of the discussed topics (e.g., media trainings) were directly related to the activities of the interviewer, some "'expected answers" cannot be excluded, despite the interviewees being encouraged to discuss these topics honestly.

Results

The results section describes in more detail the process of learning media skills. The team started with very little previous media experience, and the first press release was issued not primarily to get media attention but to aim at potential students who might want to join the project. The media attention that followed the first press release announcing the satellite project caught them unprepared, the team now admits.

> I had no experiences; I just thought you have to talk about your thing as good as you can. Our first ideas [about communication] were amateurish. For example, the first press release created a problem because we could not say what the satellite is going to do in space. This clearly raised many questions and diminished our credibility. (Interview 1)

For the project supervisor, this actualized the problem of media relations. By the end of the project, all of the interviewed team members had had interactions with the media, their nature ranging from initiating media coverage to providing short interviews, the latter being the most common form of experience. More important, they self-reported knowledge about media logic and confidence in handling media interactions, both of which can be considered good indicators for being mediatized.

Describing how they got from knowing nothing about media to being experienced in media relations, the responses from team members allow the identification of three main factors: (1) the encouraging role of the project leader, (2) reflecting on media experiences, and (3) participation in media trainings.

Role of Project Leader

The project supervisor was by far the most visible member of the team. He accounted for the majority of public appearances and became the main contact person for journalists. As he indicated in the previous quote, the lack of media awareness in the beginning created issues, which he felt could jeopardize the project. The solution for him was learning about media logic and adopting it for use for the strategic aims of the project. Following that, he, along with the project manager, worked toward actively facilitating opportunities for junior project members to interact with the media or give public presentations and participate in planning of the group's media activities and sending them to media trainings.

> I repeatedly told the team that anyone should present or talk [in the media]. I have found a few who do it with pleasure, including talking in the news, but in general this has been a painful process. . . . I have not engaged students in writing press releases but we have discussed after publication how the reaction to our press releases have been. I hope this gives them theoretical knowledge and experience. (Interview 1)

Other team members also noted the useful feedback he gave after public appearances. The encouragement of junior team members to participate in

media interactions was, hence, framed and, as several interviews indicate, also acknowledged as a valuable educational experience:

> People have come and told me later that now they understand why you made me talk about this subsystem at the press conference. The communication side, the requirement to talk about what you are doing, is something they did not get anywhere else during their studies. (Interview 3)

> This is also one skill you can learn in a hands-on project. I would say that maybe 30 percent of what we do is not scientific or technical, it's management and such things, [including] public relations. (Interview 8)

Some respondents discussed how the supervisor helped them understand media logic and influenced their attitudes toward media.

> Yes, he is really good at formulations, this is a complicated thing. At the final press conference, we discussed how to formulate, what to emphasize or not to emphasize. For example, when it became clear that the solar panel productivity is falling, we agreed to say that we completed the mission before [the power supply] went crazy. This actually was the case but we wanted to emphasize that it wasn't that we had to finish the mission because we had no energy left. (Interview 7)

> If [the project supervisor] wouldn't use media as much as he does then most likely I wouldn't see media as such a powerful tool. (Interview 8)

With both his own example and facilitating opportunities for the students, we can say that the project supervisor normalized media interactions for the team. The idea that public communication is a normal and necessary part of the scientific process echoes from many interviews (e.g., "We want to do it to popularize science so that all the scientific community would benefit from that." [Interview 8]). The team displayed a uniform understanding regarding the necessity of science communication (not only for the ESTCube project but also for science in general): foremost to account to the public, the taxpayers, but also to attract funding or students. The supervisor's media-related activities were branded as inspirational, even if not necessarily something the other team members would be able to match.

According to his own words, the learning process of the project supervisor was primarily supported by deep reflections on his own media interactions and discussions with journalists. He especially emphasized the role of one journalist, myself, in the process. At the time, I was the editor of a popular science magazine, and shortly after they launched the project, I wrote a cover

story about all the Estonian space activities, including the planned satellite. After contacting the team, they invited me to attend one of their project meetings. After the meeting and interviews for the article, I remember having a chat with the project supervisor in the lobby of the building, sharing my views on what mistakes scientists usually make when contacting journalists. I was discussing on what journalists usually consider attractive stories and what they expect from their sources. My tips to the project supervisor included preparing visual material to share with the press releases, contacting journalists directly to offer exclusives, and using other current events as cues to increase the news value of the project press releases. My motivation for sharing these ideas was the concern about the public visibility of science that was still low at the time in Estonia, which I partly put down to the lack of media skills of researchers. I was eager to help science and scientists to more public prominence, and I had had discussions about the visibility of science in the media with other scientists as well. In that respect, the first discussion with the project supervisor was not something uncommon for me personally. However, the project supervisor in retrospect attributes strong influence of this meeting:

> A good relation with this one journalist has been the most educative experience since other journalists have not given any special feedback. (Interview 1)

The initial contact was followed by some more informal discussions with the project supervisor about how to handle media interactions and his invitation to give a media-related lecture for undergraduate science students and to launch an annual science communication training workshop for young researchers. At later stages of the project, for example, during organizing the prelaunch press conference, the supervisor also worked with other media professionals, again describing this as a very useful learning process.

The project supervisor summarized the lessons received from various media professionals as follows:

> Things got a lot clearer the moment when we realized that you shouldn't just randomly try things but there are certain principles how to formulate our messages to the media. . . . You have to make things very-very easy for the journalist. The easier you make the news for the journalist to cover, the more likely it is to be covered. . . . [I learned] some general principles such as preparation of visuals and timing of the press release. All news must be well timed and connect to some larger news. (Interview 1)

> A press conference is important. It sounds much more important than just a press release. It gives TV a chance to record exciting footage. (Interview 1)

Role of Media Training

Some project members (Interviewees 2-5) took part in a media training course. The 2-day course was organized annually between 2010 and 2012 and was open to junior research and lecturing staff from all Estonian research institutions. The course was coordinated by myself and aimed at improving scientists' general motivation to communicate science, their awareness of media's operating logic, and their skills of formulating messages according to news values. The curriculum included a theoretical introduction to science communication and sessions on how to "survive" a meeting with a journalist (giving insights from both the perspective of a journalist and an experienced researcher), introduction to news values and a journalist's decision-making process, theoretical tips, and a practical exercise about writing for newspapers. The sessions were given by myself and two other prominent Estonian journalists; the handout materials included tips on how to plan and prepare press releases. The course concluded with a practical task to select a thesis and write a newspaper lead paragraph based on it.

During the interviews, I asked the team members to reflect on the knowledge and skills they had received from the training course. Their answers mostly highlighted an understanding of the journalist's point of view and insights into how to formulate messages in and for the media.

> You showed what is the journalists view on selecting news when he gets so many messages every day. How little time he actually has to write something. (Interview 2)

> Widening the world-view was definitely the most important thing. You don't think about how the article actually gets prepared and how many points there are that you have to take into account. (Interview 3)

> It gave some general principles that make a lot of sense when you think about them: such as saying the most important things in the beginning. I found it interesting that when we launched ESTCube-1 my Facebook post was used verbatim by [the public broadcaster's main news show] Aktuaalne Kaamera. Maybe we learned how to well summarize the most important thing. (Interview 5)

Compared with other team members, the course participants reported more confidence in knowing about and accommodating their media interactions to media logic. At the same time, these participants also had a higher position in the project and more media interactions during the project, indicating that a combination of factors might be behind these skills. The amplifying role of the media training was also highlighted by one interviewee:

> It is perfect when you first get a taste of [media interactions], then get [the theory] systematically and then you can again continue with practice. (Interview 3)

Role of Media Interactions

The interviewed team members had several media interactions during the project, meaning that it was possible for them to use these experiences for learning and improving their media interaction skills. The interviews show that they consciously used self-reflection or feedback from others to identify shortcomings and find ways by which to improve their media skills.

> This was all learning by doing. We did not know the result but tried. During my first experiences there was a lot of nervousness and rapid response behaviour. (Interview 3)

> I realized that I could have more standard answers ready for myself so I would not need to start thinking in front of the camera. . . . During my last radio interview, I had a page with all the things that could be asked. There I had the answers, at least on the level of keywords. (Interview 7)

> When you give an interview and later see the result, then these are two completely different things. Then you wonder why did it not come out the way I imagined it could? . . . I do try to think how I could make it so that certain things would get written the next time. (Interview 2)

As the most common media interaction situation for most interviewed team members was an interview, their main concerns were related to how to explain things and express themselves so that their desired messages would pass the journalist's selection filter. The group's leaders combined this with the thinking about target groups:

> The learning process was really intense in the beginning, after each interview I did some self-critical thinking about what could have been said differently or more clearly. In the beginning it wasn't quite clear for us how to make the point or reach the target groups. This needed a lot of polishing, thinking how to formulate the message so that it is not too complicated and would actually reach the target group. . . . You need to illustrate, give examples, consciously think about who you are talking to. (Interview 3)

> The selection of the audience, giving the whole picture and story-telling—these are mentioned so little. This sounds very simple but [it is hard] to understand what it means. You have to see it yourself, try by trial-and-error. (Interview 7)

The interviewees described routines they deploy in interactions with journalists. Most often, these included enquiring background information about the upcoming interview (length, channel, format, etc.), requesting the questions upfront by email, and requesting to have a preview of the final draft of the article (in case of print media). The main reason for these routines is better preparation for the interview (and, in case of draft checking, avoiding major errors or misunderstandings). The respondents describe preparation as an active process that enables to better control of the communication.

In addition to more general media logic, some interviewees also said that the interactions gave them an understanding of the specific logics of a channel or a journalist:

> I have learned that there is a difference between one journalist and another. I can trust those journalists I have had experience with. I know they will write objectively, trying to convey what we say. I have learned that every journalist will do it their own way. For example, the private channels always attach some intrigue to the story, while the public broadcaster takes the position of a neutral mediator. Knowing this, one has to take into consideration that one should already have prepared the [appropriate] message one wants to transmit. (Interview 1)

The group employed various methods to gain media attention and improved these strategies during the project based on analyzing the experiences. While in the beginning they mostly approached the media with press releases, these became less important during the second half of the project when press conferences and direct contact with journalists became dominant.

> I have learned that a press release is not the best device. . . . [When preparing to release some news] I would make agreements with newspapers that are ready to put the news on their front page or write a longer article. . . . I would make separate deals, give them material so by the time we issue a press release, certain channels are professionally prepared and ready to gain a certain advantage. I will help them to gain this advantage. (Interview 1)

The interview asked about how they would design communication activities in some future project, should there be one. ESTCube activities clearly served as a model for the mentioned activities, and interviewees saw themselves devoting personal resources to media relations.

> Even if it doesn't get published, some kind of [publicity] material should be produced. (Interview 7)

> It depends on the project and the point we would like to communicate. Depending on this the activities could be press conferences or just news pieces or longer articles in some popular science magazine or in an outlet for decision-makers. . . . I would make sheets with background material for the press that can easily be cited, used everywhere where necessary, along with photos or images. (Interview 3)

> I have seen it's important to have a few journalists to keep in close contact with. I also now know a few journalists and I think that this is one step for establishing a communication in which the media is responding to what you do, what you suggest. (Interview 8)

Impact of Media Attention on the Project

The previous sections detail a number of changes in researchers' personal practices related to media interactions, that is, what can be considered impactful on the interactional level. We see that among the interviewed team members, media skills are now perceived as one of the basic skills of a scientist. This means the extension of their communication sphere beyond the "normal" group of peers and adopting new patterns of interaction. However, to argue for a case of mediatization, it is also necessary to investigate whether those changes in practices also affected the project on other levels.

The interviews revealed that the project did not have a formalized structure for media interactions. No one was specifically assigned to do media relations (although, in practice, the project supervisor did the most as he had also become the face of the project in the media), and decisions such as timing and content of press releases and press conferences were often discussed collectively in project meetings. Neither was posting to the Facebook page an officially assigned task.

The project, however, included elements that were not strictly necessary for the scientific purpose of the satellite and that helped increase public attention. Most interviewees highlighted the camera of the satellite as the most important of such features. While the camera was necessary to confirm the results of the experiment (record the rolling out of the tether), the used hardware was much better than the experiment would have required. According to team members, it was planned from the start to use the camera for taking pictures of the Earth for "popularization purposes" (Interview 1).

As it happened, these pictures became an important feature in the team's strategy for maintaining public visibility. They were used as the central theme during the first year of the satellite's mission, and the camera's first image of Estonia was presented at the press conference on the 1-year anniversary of

the launch (and was simultaneously published in an exclusive newspaper front-page article on the same day). The quote by the project supervisor indicates that the publicity value of the photo of Estonia was considered so high that it influenced the team's work plans:

> [The camera] is a success story that we emphasized it a lot when we did not have much to say about the e-sail. We could talk about the camera, show a lot of material. . . . We wanted the first picture of Estonia to be ready by the press conference of the first anniversary [of the launch]. This was a motivator; we worked hard to get this picture. (Interview 1)

Another feature designed for the first anniversary was a special Morse-code signal beamed by the satellite: "The purpose was that media would use it, have a 'beep' in the news" (Interview 1). Later in the project, the team had one more similar publicity project: On Valentine's Day, a web page was set up that allowed people to send an e-card to a loved one via the satellite's communication channels.

All these examples, however, were confirmed in the interviews to have been impromptu uses of the technical systems. With the exception of the better capabilities of the camera, the design of all systems was, according to the project leaders, solely guided by scientific or engineering aims, and the publicity uses were devised only later, once the team realized the potential of various add-ons for producing media visibility. Some technical changes could have been considered if the team had developed a better sense of public relations in the early stages of the project, one interview claimed, but these would have been within the strict technical limitations of the satellite.

> We could have considered some small things that do not affect the energy [use] and the mass [of the satellite] if we had had more contact with the media and the public [in the beginning]. . . . We would have changed the technical solutions to some extent to better engage the public. (Interview 3)

As mentioned earlier, the work to produce some specific photos with the satellite was guided by the timing of a press conference. The interviews inquired whether similar pressures existed for the timing of the scientific experiment. The respondents refuted such influence from the media:

> There was a friendly pressure [from the journalists], asking "how are you doing?" but not saying that "you have failed if you don't complete [the experiment] by tomorrow." Nothing like that. . . . But we do have pressures due to funding. To submit the next [grant] proposal, we need to show the results of our experiment. (Interview 1)

However, the media interactions created what was perceived by another interviewee as a public expectation to deliver what they had promised. This acted for the team as an extra motivator:

> The decision we made in the beginning to speak about the project publicly and interact with media certainly put additional responsibility to the team and created some stress. But on the other hand it also made us take the responsibility to really finish the project and not to give up. (Interview 5)

Discussion: Mediatization of a Research Group

The Process of Learning Media Skills

Several quantitative indicators (29 issued press releases, 4 press conferences, and hundreds of news items) allow it to be argued that the ESTCube-1 project team was a highly visible research group. The interviews confirmed that the team members perceived public communication as an important part of the project and had acquired media interaction skills and confidence during the project.

In Estonia, the ESTCube project is often argued to have been a model example of good science communication: Its visibility in the media allowed it to reach a large audience, the involved scientists were good at explaining the science, and it provided the public with positive stories about science. This kind of public visibility is desired by Estonian universities and science-funding bodies (Scheu & Olesk, 2018) because it is thought to create public trust toward science and help attract students and funding.

Therefore, having a research group that progressed from a media-ignorant to a media-skilled and visible team within a well-defined time period is valuable both from the practical perspective (how to train scientists in science communication and create more visibility for science) and for the theoretical concept of mediatization (what changes in scientists' perceptions, practices, etc. are induced by the media interactions and the aspiration for public visibility).

The quick and extensive media progress of the ESTCube team can be attributed to the interplay of three key elements: the invigorating role of the group leader, participation in media trainings, and regular interactions with the media. The team supervisor not only initiated many of the media interactions that allowed other members of the team to gain experience but he also stood as a role model in terms of his attitude toward communicating with the public and constantly held internal discussions to analyze media appearances. Second, media trainings, for those team members who attended them, gave

an understanding of the journalists' work routine and thinking logic, and also helped develop a style suitable for the media. The third element, media interactions, became useful once there were several of them over time, allowing the researcher to develop, test, and polish media interaction practices.

The role of repeating media interactions was also highlighted by Poliakoff and Webb (2007) who described previous positive experience as one of the best predictors of whether a scientist will participate in public engagement. Their other major predictors were perceived behavioral control (beliefs about whether previous participation was under their control) and descriptive norms (whether scientists believe that their colleagues participate), both of which also align with the elements proposed in this study. The ESTCube case is thus able to specify the conditions that help scientists to start and continue public communication about their work. For example, better control over interactions with journalists is enabled by understanding media logic. Even if the first personal experiences are negative, a favorable general atmosphere in the research group can help turn this into a wish to improve their skills instead of being put off from media interaction altogether.

The described three elements are unlikely to be hierarchical toward one another. We cannot argue that any of these elements is more valuable to the process than the other. It can be conjectured that lack of one or more of these elements can make the process less intense or slower. For example, the team members who received no official media training were less inclined to initiate media interactions themselves. Yet the lack of any of these elements will not, with all likelihood, prevent the process from happening when the intensity of other elements is strong. It is also the other way around—the presence of these elements does not make the process inevitable. Mediatization can be resisted (Rödder & Schäfer, 2010). Hence, it is useful to treat these three key elements as favoring conditions to mediatization that amplify the effect of each other. The identification of the elements also serves the practical value of designing effective ways by which to prepare and encourage scientists for science communication activities.

The project supervisor presents one conspicuous example in which a scientist has become visible in the media and acquired good media skills without one or more of the described elements (formal media training, role model). His learning process was especially quick but did take place during the project and can be claimed to have been influenced by functionally similar elements as for the rest of the team. The supervisor also referred to learning from media interactions, and his personal interactions with journalists took the place of media training. His internal motivation—"mental mediatization"—was strong enough not to need an external role model or facilitator.

In the interviews, the team members also brought in the argument of personality—that some people are naturally more skillful in communication and others are not. Indeed, this seems to be a widespread belief among scientists, sometimes accompanied with the suggestions that one should not force the "inept" scientists to communicate their work beyond the academic circles. The other team members also sometimes attributed the media skills of the project supervisor to his personality traits. While the role of personality traits as a factor for (science) communication activities certainly deserves further investigation, it is relevant to point out that in the ESTCube team, even those members who mentioned that they are by nature not the "communication type" displayed confidence in media interactions.

Impact of Media Interactions

Following the scheme that Weingart (2012) proposed to describe the effects of mediatization, we can place most of the media-related changes of the ESTCube team on the interactional level. As scientists "normally" communicate only with their peers, the reach toward the public indicates changes in professional identity and the perception of professional responsibilities (Peters, 2013; Schäfer, 2014). The ESTCube team started to see value in public communication. Along that, they adopted a host of new practices that were instructed by media logic and integrated media actors to their outward-aimed interaction patterns. Some interviewees even argued that the skills learned in media interactions have benefited them within science, whether for giving presentations or for writing grant proposals.

Therefore, on the level of interaction, we see, on the one hand, the acquiring of personal skills that improve the scientist's communication with the public or other groups outside academia (both often take place via media) and, on the other, also the establishing, normalization, and crystallization of media relationships and interaction patterns for the whole group (e.g., organizing press conferences or having close relationships with some journalists). It is the latter that allows arguing that we are witnessing mediatization not just as good outreach. Possessing good media skills by itself does not mean that a researcher is mediatized although it does increase the potential for mediatization processes to take place. Mediatization, we can argue, enters once we observe steady interaction patterns that are driven by the individual's or group's attempts to increase their public visibility.

The difference between such relationship patterns on the interactional level and changes placed at the organizational level is that the latter level deals with formal structures. The ESTCube team did not institutionalize their

media relations, so we can argue that their media activities reflect changes on the interactional level.

From the practical perspective of science communication, achieving and supporting such changes at the interactional level are obviously of interest since they reflect the capabilities of scientists to increase the public understanding of science. At the same time, public visibility can also be supported with changes in other aspects of a research project, not just the interactional. In the case of ESTCube, the properties of a subsystem were influenced by public visibility considerations: The camera exceeded scientific mission requirements and allowed taking high-quality photos of the Earth, which were then used in public communication. The capabilities of other satellite components were also used for activities aimed directly at the public or the media, for example, beaming a special message or setting up a possibility to send a Valentine's greeting via the satellite.

A decision to change the technological setup of the satellite for public visibility reasons would be a clear indication of changes on the program level of science, that is, affecting how and with what tools science is done. The camera of ESTCube-1 was such a decision. Other component choices, according to the interviewees, were solely guided by scientific or educational considerations (i.e., developing the components in-house to allow students to gain maximum experience) because the satellite's size, weight, and energy use limitations left very little space for nonessential hardware capabilities. The team had more freedom for developing software solutions and prepared several to be used for public visibility purposes.

The publicity aspect became relevant for the team and consciously used by them only during the later stages of the project, helping to explain why there are fewer changes on the technological level. Had they had more public interaction experiences at the stage when the satellite was designed, they would have discussed adjusting the technologies, according to one interview, to allow more public engagement.

An indication of a program-level change for science can be seen in the very decision to build a satellite, considering the potential public attention to such research project. The interviewees argue that the choice aimed to serve education purposes: It was meant to attract students and provide them with a challenging and engaging project. Similarly, the first press release that they sent out at the beginning of the project was aimed at potential students. These decisions were not consciously made to achieve public visibility but nevertheless turned out to be important prerequisites that helped trigger the mediatization process. The novelty of being Estonia's first satellite contributed to their media success, but the speed and intensity of mediatization was enhanced by their own understanding that communication with the media

and the public is important. Therefore, ESTCube represents a case of mediatization, where both "push" and "pull" forces contributed to mediatization (i.e., the process was triggered both by the media and within the group itself; see Marcinkowski, 2014). Since ESTCube-1 was not accountable to funding institutions, it can be said that they substituted this with accountability to the public and the media.

ESTCube-1 was not a standard research project. Many of its features, from funding scheme to the level of involvement by graduate students, were unusual by the prevailing scientific practices. Therefore, it cannot be argued to represent general trends in science, and the small sample and author's involvement might raise questions about how representative the case is. However, the power of the ESTCube case lies in its capability to illuminate what can be argued to be the universal process of mediatization, in this case, it being especially quick and its drivers clearly identifiable. The universality of the process comes from the fact that it is guided by media logic, not the logic of the specific scientific project. To use a spaceflight metaphor, the different framework conditions are like the characteristics of the rocket launch that affect the speed and intensity of mediatization, but the "gravitational pull" of the media means that different rockets will still end up on the same orbit. Therefore, it provides us with a model to understand how microlevel mediatization is likely to take place in science.

Conclusion

As science institutions are more and more interested in public visibility, see this as a vital resource, and are undertaking adaptations to achieve more visibility (Scheu & Olesk, 2018), we can expect individual media interaction practices, such as those described in this study, and ESTCube-like media-attractive projects to become more common in science. These would then present themselves as an important testimony for the mediatization of science. This process is supported by the understanding shown in a study by Scheu et al. (2014): Scientists perceive that these adaptations complement, extend, or protect core functions of their activity or organization.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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III

Olesk, A. (2019). Media coverage of a strongly mediatized research project: the case of the Estonian satellite ESTCube-1. *Mediální studia / Media Studies*, 13 (1), 7−27.

MEDIA COVERAGE OF A STRONGLY MEDIATIZED RESEARCH PROJECT: THE CASE OF THE ESTONIAN SATELLITE ESTCUBE-1

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ABSTRACT

The perceived value of public visibility has led research institutions and individual scientists to integrate the logic of the media into their communication practices, a process known as 'mediatization'. This paper investigates the media coverage of the Estonian satellite project ESTCube-1 (2008-2015), whose members, according to a previous study, were mediatized, i.e. skilled and proactive in media interactions. The wide and positive media coverage of the project was mostly driven by events organized by the project team and lacked outside or critical voices. The comparison of the angles presented in press releases (n=30) and in original media coverage (n=160) shows that media reproduced the framings presented to them, including the emphasis on the educational nature of the project. The purposeful application of media logic by scientists is one factor to explain the intensity and nature of the media coverage, pointing to the need for further research about the impact of mediatization processes on media content and media autonomy.

Keywords: science journalism ▪ mediatization ▪ science communication ▪ media logic ▪ space ▪ satellite

1. INTRODUCTION

The visibility of science in the media is often considered a key goal of science communication activities and is emphasized in many strategy documents both by research and research-policy institutions (e.g. Estonian Research Council, n.d.; Steering Committee for a National Science Communications Strategy, 2009; The Royal Society, 2006). The perceived value of public visibility has led research institutions and individual scientists to integrate the logic of the media into their communication practices, a process known as 'mediatization' (Hjarvard, 2013; Marcinkowski, 2014). Several studies (Peters et al., 2009; Rödder & Schäfer, 2010; Schäfer, 2011; Scheu & Olesk, 2018) have argued that the perceived need to foster media and public attention has led to changes in science on the level of individuals (e.g. use of promotional

language) or organizations (organizing press conferences, hiring of communication professionals etc).

Concurrently, a "growing intensity of mass media coverage" of science (Franzen, Weingart, & Rödder, 2012, p. 4) has been noted. Schäfer (2009) adds that science coverage in media is also characterized by more diversity in terms of actors and content, and the increasingly controversial nature of coverage. At the same time, the coverage is also driven by the rise in institutional press releases that are often published without major changes (Granado, 2011; Mathelus, Pittman, & Yablonski-Crepeau, 2012). This has been attributed to both the reduction of resources for specialized science journalism, referred to as the 'crisis of mediators' (Bucchi, 2013), and the strengthening of science PR (Göpfert, 2007).

It is evident that the changes in science institutions and the challenges science journalism is facing (Allan, 2011) will lead to rearrangements in the science-media relationship with effects on both. For science, the adoptions constituting the mediatization process can bring more public visibility to support the strategic functions of science institutions (Scheu, Volpers, Summ, & Blöbaum, 2014) but might also threaten the autonomy and values of science (Weingart, 2012). For media, the process of mediatization demonstrates its importance for other social institutions such as science (Hjarvard, 2013). At the same time, the vulnerability to PR pressure is likely to increase with the mediatization-led changes in the interaction patterns between journalists and their sources. Therefore, we should consider the mediatization of science as one of the processes that shape media coverage of science. Currently, most studies of media coverage of science look at crisis situations or topics that include contested elements (e.g. climate change or vaccines). There are less studies on the 'routine' coverage (Rödder & Schäfer, 2010) of science and in those cases, the characteristics are not easily linked with the role of the researchers in shaping the coverage.

This paper uses the example of the Estonian satellite project ESTCube-1 (2008-2015) to explore the media coverage in the case of a mediatized science-media relationship. The first Estonian satellite ESTCube-1 was built by a team of students and its scientific mission was to test a tether of the e-sail (electric solar sail), a novel space engine concept (Envall *et al.*, 2014). The project was announced in 2008, the satellite was launched in May 2013 and it concluded the mission two years later without succeeding to run the e-sail experiment due to a technical malfunction.

The case of ESTCube is well-suited for such analysis for several reasons. The project had a clear time frame, making it possible to follow all relevant media coverage. The media visibility the ESTCube achieved throughout the course of the project was substantial and the project is therefore considered by the Estonian science communication community to be one of the biggest local science communication success stories. Qualitative interviews with the research group developing and launching the satellite confirmed that they can be considered a strongly mediatized research group (Olesk, 2019). The interviews showed that the team considered journalistic media an important channel for their communication and perceived the media as

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having a distinct logic to which they need to adopt to in order to get their message to the target groups. These results also revealed that the team members were personally active in managing media relations, including preparing press releases and establishing close relations with a small number of journalists who reproduced the agenda of the research group. Therefore, the researchers did not perceive adaptation to media logic (i.e. mediatization) as a threat to the autonomy of science but rather as a tool to achieve their strategic goals.

In the theoretical part, the paper builds on the concept of mediatization and presents discussions on the role of science journalism and public communication of space activities. The empirical part summarizes the characteristics of ESTCube's media coverage. The research questions guiding this study are as follows: 1) *What are the main characteristics of ESTCube-1's media coverage?;* and, 2) *In comparison, what angles and to what extent are present in the news articles and in the press releases?* By addressing the questions, the study aims to contribute to our understanding of both (science) media and mediatization, allowing to get a more nuanced picture of the relationship between science and the media and help to reconstruct the processes that shape media coverage of science. In the last section of the paper I argue that key characteristics of the coverage can be explained by the mediatized interaction pattern between scientists and journalists.

1.1 The role of science journalism

Hansen (2009) has noted that science journalism/news is often considered 'different' from other types of news, mostly due to a different relationship with their sources. Science journalists are often perceived to be closely allied with the scientific community and dependent on it (Gregory & Miller, 2000, p. 107) leading to an uncritical and deferential science coverage (Hansen, 2009; Nelkin, 1995). Research has also pointed out that science articles tend more often to use just a single source (Blöbaum, 2017). The theoretical literature agrees (e.g. Blöbaum, 2017)that science journalists should be critical observers and not in the service of science's agenda. Bucchi (2004) suggests that science writers, however, more often view their 'professional mission' in terms of popularization, in contrast to news journalists who describe their mission in terms of public need for information and expression of public concerns..

The science journalists themselves, however, do identify themselves as "journalists first and specialists second" (Hansen, 1994). According to Nelkin (1995, p. 100), "they strive to maintain the respect of their scientific sources and to satisfy the ideals of science, but they must, first and finally, meet the constraints of their own profession." This includes adhering to the common principles and practices of selecting content ('news values', see Harcup & O'Neill, 2017) and its form of presentation, in order to fulfil the role of journalism in the society and to meet to goals of the media channel. The results of journalists applying such 'media logic' (Altheide, 2013) to science coverage have often been viewed critically, pointing to issues related to negative

coverage, accuracy (Hansen, 2016), imbalance (Boykoff & Boykoff, 2004), hype or scaremongering. This is most directly in contrast to the way science is presented within the scientific community, therefore it is easy to perceive the media as "invading" and its logic undermining or threatening the logic of science (Franzen *et al.*, 2012).

Meanwhile, more and more scientists take part in science communication trainings where they are taught elements of that 'media logic' to improve their public communication skills (Besley, Dudo, & Storksdieck, 2015). The 'pull' towards media (see Marcinkowski, 2014) is also evident from the fact that research institutions increasingly add resources for communication, e.g. by hiring more communication professionals, and implement other organizational changes to improve public communication (Scheu et al., 2014). These activities are driven not as much by the wish to increase public understanding of science, but foremost to increase public and political support for science and the hope to gain advantage in competition for resources such a funding, students or political impact (Borchelt & Nielsen, 2014; Scheu & Olesk, 2018).

As a result, the scientific sources "are often acutely aware of the importance of the framing process, so will make every effort to try and ensure that their preferred definition of the issue or event is placed in a positive light," Allan notes (2009, p. 158). Given the long history of close collaboration with science journalists and a traditionally strong role of scientific sources in agenda-setting in science media (Hansen, 2009), the research institutions sometimes forget that "news media do not see it as their mission to help . . . universities . . . to build a better world." (Fjaestad, 2007, p. 130). The expectation to support the strategic goals of science institutions can be a source of further tensions between science institutions and the media. At the same time, the role of the media is recognized as crucial (also by the media themselves) in the dissemination of accurate information and in the deliberation process of important societal issues, including scientific questions such as vaccines or climate change.

The various perspectives on science journalism show that the commitments expected from them include both enhancing public understanding of science (and public engagement with science) and maintaining the values of objective journalism. Mediatization processes taking place in science can magnify the tensions created by these, sometimes contradictory, expectations. Therefore, we must ask how mediatization impacts the capabilities of media to fulfil those roles, considering that science journalism operates on the boundary of science and media, constantly negotiating the 'logics' and boundaries (Kunelius, 2014) of both fields and the relationship between journalists and their sources.

1.2 Public communication of space activities

The review of literature on the communication of space-related activities shows that the question of public support is taking the centre stage. Although public support is

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often taken for granted (Entradas, Miller, & Peters, 2013) and some space exploration ventures like Mars rovers are still able to attract significant public interest and generate media attention, public opinion surveys both in the USA and in Europe reveal a more critical position towards space activities. For example, they are perceived "risky, expensive and not very useful" (Ehrenfreund, Peter, & Billings, 2010) and a lesser priority for expenditures compared to healthcare, education, childcare and defence (Finarelli & Pryke, 2007). The US studies also show that the biggest support comes from a socio-demographic group who could generally be described as 'Apollo generation' (i.e. people who were young during the first Moon landings, see Nadeau, 2013; Whitman Cobb, 2011). While the 2005 Eurobarometer survey (European Commission, 2005) shows that in Europe the interest for space and astronomy is highest in the age group 15-24 (with 28 % of the age group interested), several studies indicate that knowledge about space issues in this group tends to be poor (Miller, 1984, Entradas & Miller, 2010; Entradas et al., 2013; Jones, Yeoman, & Cockell, 2007; Joyce, Ferguson, & Weinstein, 2009; Ottavianelli & Good, 2002).

For space agencies, the possible negative implications of this decreased support and interest include less funding for future space activities and lack of scientists and engineers. While the correlation between public support and funding of space agencies is not a straightforward one (Steinberg, 2011), the drop in the relative number of science and technology students has been observed in all OECD countries. The space agencies have responded to this by extending their communication and outreach programmes. „Public engagement should be a Level One requirement for exploration," asserted space experts during a workshop on building and maintaining the constituency for long-term space exploration (Finarelli & Pryke, 2007, p. 17). Other papers, analysing communication of bioastronautics (MacLeish et al., 2005) or planetary protection program (Billings, 2006) have made similar suggestions.

The perceived need for public communication presents a clear driver for efforts to increase visibility in the media. Next to that, the quoted papers (specifically also Allner *et al.*, 2010) focus on educational programmes as the main way to heighten public support for space science initiatives. These activities aim to grow the new generation of public described by Miller (1984) as attentive: both interested and knowledgeable. One example of such of educational projects are nanosatellites (including CubeSats), mostly undertaken by universities to allow students to get hands-on experience with space projects and promote careers in space industry. Outreach and educational goals are strongly highlighted in papers discussing CubeSat mission design, like ESTCube-1 (Slavinskis *et al.*, 2015), the Danish AAU CubeSat (Alminde, Bisgaard, Vinther, Viscor, & Ostergard, 2003) or the proposed European Student Moon Orbiter (Walker & Cross, 2010). Since students are nearer to the public than big space agencies, CubeSat projects (e.g. Muñoz, Greenbaum, Campbell, Holt, & Lightsey, 2010) have also been used as a community outreach tool when students communicate their work, usually to other students, high school pupils or general audience.

The outreach of outreach, i.e. the promotion of the educational and outreach

elements of space projects fulfils a necessary role of space communication as emphasized by Finarelli and Pryke (2007, p. 16): "To build public support, . . . it is also necessary to ensure that what an enterprise does is indeed valuable to the public, is indeed relevant to them." That a similar strategic goal – using an educational approach and highlighting the societal relevance of the project to ensure public support – characterized the ESTCube-1 project, was shown in a previous study of the mediatization process of the ESTCube-1 project (Olesk, 2019). This study will explore the role of media for helping the team to achieve this strategic goal by analysing the public visibility and the messages in the media content.

1.3 Mediatization

Mediatization describes the interrelation between changes in media and communications on the one hand, and changes in culture and society on the other (Couldry and Hepp, 2013). The institutionalist tradition of mediatization research understands media as an autonomous social institution whose operating logic influences other fields or social institutions such as science, politics, religion or sports. Hjarvard (2013, 2014) sees mediatization as "institutionalization of new patterns of social interaction" and "change of institutional characteristics". Commonly, these changes are being sought in the social institutions responding to the omnipresence of media. For example, in his 2008 paper Jesper Strömbäck defined the four phases of mediatization using the example of politics: media becoming the most important source of information, media becoming an autonomous institution, (political) actors start adapting to media logic, and, finally, the actors adopting media logic to the extent that it becomes internalized to their institutional processes (Strömbäck, 2008).

A frequent critique of the mediatization approach has pointed out the difficulty of empirically verifying or evaluating the process of adopting to media logic. Most of the proposed indicators to evaluate mediatization discuss the practices of individuals and organizations, e.g. employing professional public relations staff, proactively initiating a „catastrophe discourse" (when discussing climate science) or using „promotional metaphors" (Schäfer, 2014). In case of routine coverage, formulating key messages and preparing lay explanations can be considered new interactional practices indicative of mediatization (Olesk, 2019).

The changing interaction patterns by the actors should be reflected in the media coverage, e.g. by making certain scientists or science topics more visible in the news. Therefore, a better picture of mediatization outcomes could be achieved if we complement the description of practices with the analysis of media content that is created in the context of mediatized interaction processes. The major challenge with this approach is, how to validate the presence or extent of mediatization based on media content? How to isolate the media logic inserted by the journalist from that of its sources?

It is clearly impossible to achieve this based on media content alone. Yet, media

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content can become a valuable source when combined with other sources of information such as insights into the media practices of the researchers and content directly produced by them. A concurrent study (Olesk, 2019) has shown a close relationship between the ESTCube team and journalists and the mediatized characteristics in their interaction with the media. We also know that the team wrote all of their press releases themselves. This study adds the characteristics of ESTCube's media coverage as a starting point to the discussion whether and to what extent these characteristics could be attributed to the mediatized interaction patterns. A comparison of press releases with the media coverage serves the purpose of indicating how much the core agenda of the team (as reflected in press releases) was present in media coverage.

The research questions guiding this study are thus as follows: 1) *What are the main characteristics of ESTCube-1's media coverage?;* and, 2) *In comparison, what angles and how much are present in the news articles and in the press releases?*

2. METHODS

The study combines the quantitative content analysis and rhetorical analysis of press releases about ESTCube-1 (n=30) and journalistic media items from Estonian media (print and online articles from newspapers and magazines, TV and radio clips; n=160). The sample aimed to include all media material that was produced about the project during its duration: from July 2008 (when the first press release was issued announcing the project) until May 2015 (when the satellite stopped working).

For the study, I gathered press releases from the web archives of the University of Tartu and the Estonian Space office. The press releases were written by the team members and distributed by the university press office. Regarding the media items, I selected only original journalistic material, meaning that the item had to be based on an interaction between the journalist and at least one project member or a person commenting on the project. This means that rewrites of press releases and items based on other secondary material such as Facebook posts or already published media items were excluded from the sample. In addition, I added editorial content (e.g. opinion articles by journalists).

I combined various sources to gather the media items. The team kept a public media log during the first few years of the project. The Estonian libraries' article database ISE provided additional print articles and I searched the archives of all major Estonian news channels and outlets with the keywords "ESTCube" and "student satellite".

I coded the items for basic characteristics (such as place and date of publication, author, length, quoted sources). The main feature that was identified in content analysis is the element described as 'angle'. The angle is understood in this study as the presentation of a distinct facet of the project. As the ESTCube project had several facets, such as the scientific mission or its educational purpose, the highlighting of

various facets in press releases and media items illustrate the representation choices made by the sources and the journalists. However, angles are, in this case, not to be understood as types of representations or frames. Both of these imply a selection from a larger set of beliefs, meanings and rhetorical tools which then together constitute an organizing principle or structure guiding the reader's understanding of the issue, whereas angles simply describe what part of the project is highlighted, not how it is done. Several angles may co-exist in a text.

The angles were coded in a two-step process (Charmaz & Belgrave, 2012): during the initial or open coding I identified the angles, then used selective or focused coding to find up to three most salient angles per item. To be coded, the angle needed to be elaborated in the text, not just mentioned. All coding was done by myself.

In total, ten angles were identified:

- *Organizational*, describing the current state of the project, organizational arrangements, and future steps;
- *Scientific*, explaining the nature of the E-sail and its potential use in future space exploration; other research results of the satellite;
- *Engineering*, explaining the building of the satellite, technical aspects and challenges of the project;
- *Educational*, highlighting the use and impact of the project as a study method;
- *Outreach*, describing the use of the project to promote STEM-subjects;
- *Co-operation*, with other universities or companies;
- *Societal impacts of the project*, such as economic benefits, national pride, etc.;
- *Outside reaction*, focussing on awards, recognition, or critique;
- *Personal*, introducing people in the project;
- *Other related topics*, such as spin-off companies, photo contest, etc.

The quantitative data is supported by rhetorical analysis of the texts, especially looking at the quotes by scientists and editorial comments. Rhetorical analysis involves unravelling formal external characteristics of the language used by a detailed reading of fragments or larger units of text (Gunter, 2000). These characteristics allow analysing the rhetorical devices used by the researchers in interaction with the journalists (which might function as indicators for mediatization) or identify the critical or supportive position of the journalist.

I paid special attention to reflexivity during the whole research process due to my personal involvement with the case under study. At the time of the project, I worked for various Estonian media outlets as a science journalist, also covering the ESTCube-1 project. In total, I wrote seven newspaper and magazine articles that are included in the sample. Being able to closely follow the mediatization process of the research team sparked interest towards the case in the first place and guided the direction of research once I starting my PhD in 2013.

While the question of the effect of researcher's position is more commonly addressed in the case of qualitative research and quantitative content analysis is often perceived to be 'objective', it is clear that all stages of the research are influenced

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by the personal background of the researcher (Gentles, Jack, Nicholas, & McKibbon, 2014; Malterud, 2001; Mruck & Mey, 2007). The common response to the concerns related to this is "a commitment to reflexivity" (Malterud, 2001, p. 484), with reflexivity understood as "the process of a continual internal dialogue and critical self-evaluation of researcher's positionality as well as active acknowledgement and explicit recognition that this position may affect the research process and outcome" (Berger, 2015, p. 220).

This paper follows the recommendation by Corbin and Strauss (2008) of using personal experiences during data analysis. These experiences can be brought into the analysis in a way that maintains primacy of the empirical data when incidents from the researcher's experience are compared at the conceptual level to incidents in the data to bring out properties and dimensions of which both incidents are examples (Gentles et al., 2014). For example, the understanding of how journalists managed the agenda-setting by the ESTCube team was developed via comparison of the content of other media items with the critical reflecting of personal experiences from interactions with the ESTCube team members and their impact on my own journalistic articles.

3. MEDIA COVERAGE OF THE ESTCUBE-1 PROJECT

3.1 Analysis of press releases

The team issued press releases during the whole project, which speaks for a conscious media strategy. 29 of the analysed press releases were published by the University of Tartu (having being prepared by the ESTCube team) and one by the Estonian Space Office. During most years of the ESTCube-1 project, 1-3 press releases were issued per year. The most active year was 2013, the year of the launch, with 17 press releases, 10 of which were issued during April and May. The satellite was launched on May 7, 2013, after being delayed for two days, and most of the press releases from May provide up-to-date information about the launch situation.

The surge of press releases during the launch period (April/May 2013) also contributes to the *organizational* angle being the most common: it was present in 43 % of all the press releases but 80% of the launch period press releases contained this angle with a clear goal of responding to media interest for ongoing events. During the remaining periods, the *organizational* angle was present in 25% of the press releases.

The press releases were used to explain the aims of the satellite project: the *educational* angle was used most often (37 % of press releases), followed by *scientific* (27 %). The *engineering* aspects were discussed in more length in 17 % of the press releases. Almost one out four press releases (23 %) discussed *outside reactions*, mostly awards and recognitions given to the project.

While educational and scientific goals were most often elaborated in the press releases, the texts strived to emphasize the multi-faceted nature of the project,

usually highlighting other aims over the scientific. For example, the following summarizing paragraph was found in several press releases:

> *"The Estonian student satellite program was initiated in 2008 by the students and lecturers of University of Tartu with the aim of popularizing science and engineering subjects, giving students practical experience and developing entrepreneurship. The scientific mission of the ESTCube-1 satellite is to test the components of the electric solar sail."*

The most visible actor was the project initiator and supervisor Mart Noorma, who featured in 24 press releases (80 %), followed by project manager Silver Lätt, who was quoted in a third of the texts. Besides them, the press releases featured five other team members and 14 outside actors, mostly representing academic, public or business sector. The role of the outside actors in the press releases is usually to express support to the project and amplify its messages related to various benefits of the project. For example, the team issued a press release when then Prime Minister Andrus Ansip mentioned ESTCube-1 in his parliament speech about science and innovation. He was quoted as saying: "Despite only having a 1-litre volume, [the satellite's] benefit can already today be measured in cubic metres." The inclusion of outside actors can be considered an adaption to media logic which appreciates a diversity of sources.

The analysis also looked at the effect of press releases on media coverage by identifying the media items that were thematically identical and published or aired within a week after the press release (excluding coverage related to events – the launch and three press conferences by the team). The results show that the press releases were able to produce up to three original items in the whole Estonian media (usually none or one). It is also notable that in the post-launch phase of the project several press releases *followed* prominent media coverage, i.e. they both reported about the project-related news or event and also provided links to various media items that had been already published about the same news or event. Personal experience and previous interviews (Olesk, 2019) indicate that the team at this stage no longer considered press releases as an efficient tool for initiating media visibility but preferred using personal contacts with journalists or organizing large press conferences.

3.2 Analysis of media coverage

The media coverage sample includes 160 original journalistic items (43 radio clips, 43 TV clips and 74 print and online articles). All main Estonian media channels/outlets covered ESTCube, showing a trend that the bigger audience the channel/outlet has, the more it covered the project.

Figure 1 (below) shows the distribution of media coverage and press releases over the course of the project. Similar to the distribution of the press releases, more than half of the coverage (59 %) concentrated on 2013, the year of the launch. The first

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three years of the project had 3-5 original media items per year and the final year of the mission (2015) saw another peak with 20 items. On other years, the number of media items was between 10 and 12.

Most coverage was related to events (see Figure 1): 23 items were connected with the launch, 11 items with the first major press conference in January 2013 when the satellite was shown to the public before the launch, and another 11 items accompanied the February 2015 press conference about the end of mission. The third press conference, celebrating one year in space, inspired seven media items. One more coverage spike was in August 2013 when the satellite had several close encounters with space junk. No press release was issued about this incident.

The timeline on Figure 1 demonstrates that the ESTCube project was constantly visible in the media from beginning of 2011 until the end of the project (having at least one original media item per 3 months). The only gap in press releases and coverage was between May 2014 and the end of 2014. This was the time when the team tried to conduct the scientific experiment. The fact that the experiment failed was revealed only in the final press conference in February 2015, indicating that the team deliberately kept a low profile during the experiment and after learning of its failure.

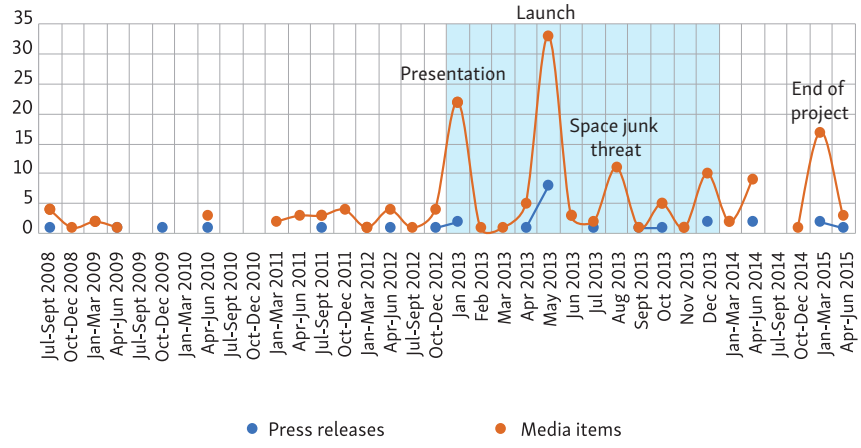

FIGURE 1. Timeline of ESTCube press releases and media items (units on time-axis represent three-month sections, except for the launch year – 2013, on background – which is presented month by month)

The two individuals most prominent in the press releases (Mart Noorma and Silver Lätt) were also most visible in media, being present in 76 % and 12.5 % of the items, respectively. The third position was occupied by an outside actor – Ene Ergma, a well-known astrophysicist and, at the time, the speaker of the parliament. She featured in 14 media items while being present in none of the press releases (although media

coverage indicates that she was present is some of the events for the press). She presented herself in the media coverage as a strong supporter of the project.

Most media items were produced by various channels of Estonia's Public Broadcasting – 27 by its main TV channel and 18 by its main radio channel. Estonia's biggest daily, *Postimees*, had 24 articles and the main commercial talk-radio channel, *Kuku*, 20 items. Altogether these four major channels produced more than half of the total coverage. Concentration of coverage to certain channels is also obvious in comparison between similar type of channels: in TV, the main commercial channels produced 8 and 9 items respectively (compared to 27 in the public broadcaster). The 24 articles on *Postimees* stand out in comparison with 13 in the main tabloid newspaper, 6 articles in the second-biggest daily and none in the main business daily. The pattern indicates concentration of the coverage to the channels with most visibility and weight in the society, matching the media visibility goals of the team.

The most prolific author was Villu Päärt (10 articles), a writer for the University of Tartu-owned science news website *Novaator*. The science editor of *Postimees* (i.e. myself) produced 7 items, as did the science editor of the radio channel of the public broadcaster ERR. Another four authors had 5 items each. This shows that the ESTCube team established relationships with some journalists who reported about them throughout the project, indicating an interactional pattern characteristic of mediatization.

Figure 2 (below) shows the prevalence of angles in the press releases and media coverage. Compared to the press releases, the *scientific* and *engineering* angles were more pronounced in the media items. Not surprisingly, the dominant angle (present in 79 % of media items) was *organizational* – updating what is happening with the satellite (see Figure 2). 39 % and 27 % of the items, respectively, dedicated time and space to explaining the science results and expectations, and the technical aspects of the satellite.

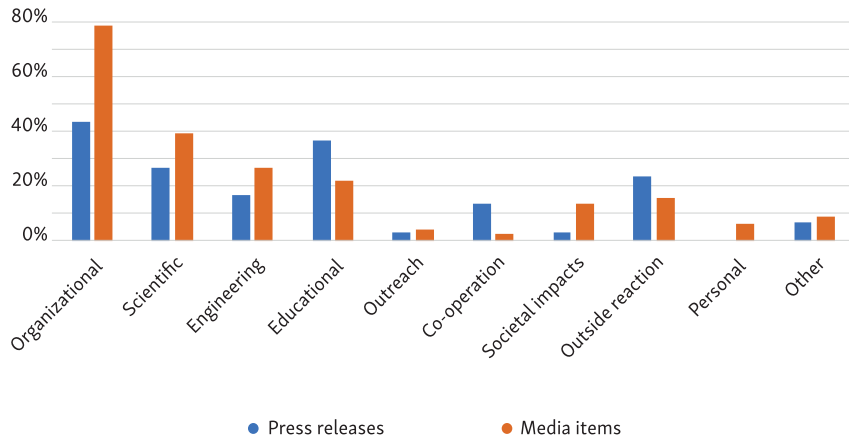

FIGURE 2. Percentage of the press releases and media items with identified angles.

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The *educational* angle received elaboration in 22 % of the media items – less than in press releases but still being quite visible. The rhetorical analysis reveals that this result was impacted by agenda-setting by the sources: they frequently highlighted this aspect of the project in the interviews but were not always allowed by the interviewing journalist to elaborate it further.

A similar pattern can be observed with the angle *impact to the society*. Especially in the TV and radio interviews, the team members often found ways in which to introduce the wider societal aims of the project whereas the original question by the journalist might have concerned something else. This is a characteristic example from the TV breakfast show:

> *Host: "What is the mission of the satellite?"*
>
> *Mart Noorma: "To support Estonia's economy and support Estonia's reputation as a country capable of developing high-tech. This is the most important mission. But in scientific sense [the mission is] to test components of the electric solar sail."*

Sometimes the journalist would then guide the conversation back to the scientific and engineering aspects, avoiding elaboration. But especially the journalists who reported about the project several times adopted the frame and also started highlighting the *educational* and *societal impact* angles in their items. For example, these aspects featured heavily in the media coverage when Mart Noorma was declared Person of the Year 2013 by *Postimees* newspaper.

The quotes by the team members show that they understood how media expects them to communicate science: it is evident from the way they simplify, use examples and comparisons to explain science and technology, and add intriguing facts[1]. While using grand statements when discussing the wide societal impact of the project (such as contribution to the growth of the economy and increasing national happiness), they talked about the potential results of the specific science experiment much more cautiously and, hence, similar to the style used in academic articles and can be thus considered an element representing science logic.

The team managed expectations of the public by emphasizing the complexities of and risks related to space engineering and science which creates uncertainties about whether the satellite will complete all planned tasks (or even start operating at all). The team also placed their work in a bigger scientific context by describing all the incremental progress that is needed to realize the electric solar sail.

The presence of only a very small number of critical voices and outside actors among all the coverage shows that the ESTCube team managed to own the topic in the media and actively guided the framing of the project. In 2008, just after the first announcement, a space engineer wrote a critical opinion piece, doubting the

1 The press conference dedicated to the end of the mission is a good example: https://www.uttv.ee/naita?id=21515

meaningfulness of the endeavour. But otherwise, no-one openly criticized the project or questioned the claims made by the team. Among the sources quoted in the items there is no-one who could be considered an independent expert. Rather, all non-project sources are somehow affiliated with the project and express their support to the satellite team.

The announcement that the satellite could not complete its main scientific mission, testing of the component for the electric solar sail, was presented at the final press conference. The role of the failure of the scientific experiment to the overall success of the mission was downplayed in the statements on the team. A similar framing had been present also before: a recurring quote throughout the later stages of the project was that 90 % of the whole mission had already been successfully accomplished by completing the building of the satellite.

The team achieved a successful reframing of the criteria for the project's success. Most journalists covering the final event followed the proposed framing of overall success, putting their focus on emphasizing other project outcomes or introducing upcoming missions and not highlighting the failure of the scientific mission. This contrasts the previous coverage where the e-sail experiment had featured prominently and journalists often built their story around it. One of the most frequent questions to the team after the launch was: 'When will you conduct the experiment?'

Some subtle critic to the proposed framing of the project's success came only from two experienced journalists. One of them referred to earlier statements by the project members that tied the success of the mission to the success of the scientific experiment and wrote: "It would be very unfair to consider ESTCube-1 in any way unsuccessful yet it would be fair to call it partially, not completely successful." The other journalist was the only one to critically address a central claim the team used to describe the success of the project – that the project was scientifically relevant, producing a high number of academic articles. He pointed out that most of these articles had been published in journals with a very low impact factor. However, neither of these critiques was addressed by the team or discussed any further in the media.

4. DISCUSSION

ESTCube-1 represents a science story that received a wide and positive coverage in the media. The journalists acted in a typical science popularization framework. They made efforts to explain the science and technology behind the project, strived to inspire the young generation and make STEM-subjects look more attractive. Their selection of sources can be argued to show (and incite further) trust towards scientists. All in all, the coverage contributed to the overall positive image of science and technology, and is thus similar to how science community expects media to build public support for their activities.

At the same time, we also see that media allow the sources to control the agenda. We know from previous research that the team aimed to develop close ties with

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a number of journalists in media channels with high visibility (Olesk, 2019). This paper shows that some journalists in such channels did indeed report extensively on the project, while the timing of articles or news clips indicate that they sometimes received exclusive information. These journalists preserved and even amplified the framing presented by the team (e.g. about the multi-faceted nature of the project) and sought no independent experts or critical voices as sources.

It is likely that the nature of ESTCube contributed substantially to media's stance. It had 'sex appeal' and "managed to strike many of the right chords in the 'basics of a successful journalistic subject' all at the same time" (Carra, 2007) to use the words once used to describe the story of Dolly, the first cloned mammal. ESTCube was extraordinary – the very first Estonian satellite, testing a potentially revolutionary technology for interplanetary travel, a potential source for national pride. However, the media skills of the team members should not be underestimated in explaining the amount and nature of media coverage. The ESTCube team communicated with the public throughout the project, issuing a number of press releases and turning each project milestone into a media event. Despite the fact that the team's scientific work and progress was introduced at these events, none of these events were mainly being driven by scientific reasons but rather organizational or other milestones: finishing the building of the satellite, launch, one year in space, or closing of the project. The interaction patterns established by the team – the press releases, press conferences, close relationship with a selected number of journalists and good communication skills – provided the project constant visibility and a mechanism through which to influence the media content. In the end, we see that the ESTCube-related sources and frames prevail in media content.

The comparison of angles in press releases and media content shows that angles from the press releases that got amplified in the press can be matched to the theory of news values (Harcup & O'Neill, 2017). The story of the satellite (*scientific* and *engineering* angles) gained media attention in the first place because it was *surprising* (the first ever Estonian satellite, a novel space travel technology), concerned a *powerful* organization (university), was *relevant* (involved Estonians) and promised *good news* (a successful experiment). Later coverage was also driven by *following up* the progress of the satellite, explaining the prominence of the *organizational* angle. During the project, the team used additional news values to support constant visibility such as *exclusivity* (offering a story to one journalist only), *drama* (satellite threatened by space junk) and *magnitude* (the project will benefit the whole country).

The *educational*, *co-operation* and *outside reaction* angles, at the same time, represent the aspects that are important for the research team and their institution but can be argued to lack a strong news value that would make journalists perceive them as relevant for their audience. Therefore, they are underrepresented in media coverage when compared with the press releases.

However, the *educational* angle is still well represented in media coverage, being salient in a fifth of media items. Their *educational* agenda was persistently brought

forward by the ESTCube team in all their communication and we also see it being adopted by journalists.

How are these results relevant for the study of mediatization? They point to an important avenue of further research for a deeper understanding of mediatization and its effects – how journalists respond to the use of mediatized practices of the sources. A previous study of ESTCube team members (Olesk, 2019) showed that for researchers, reflection on media interactions was an important learning method. It shaped their understanding of media logic and honed their skills of getting their agenda published or broadcast.

The extent to which the sources are successful in this quest is determined by the response of journalists. In case of ESTCube, we can hypothesize that the supportive rather than critical behaviour of the journalists became a factor that created additional opportunities for the mediatized practices of the research team to shape media agenda and content. If the mediatization of another social institution is strong (i.e. its representatives purposefully apply media logic to achieve media visibility and fulfil their strategic goals) we may ask whether it increases their abilities to control media content at the expense of media's autonomy or its journalistic norms and values.

It may be so if we understand mediatization necessarily as a zero-sum game of the competition of logics. Marcinkowski argues (2014) that adopting media logic does not necessarily mean that the values or principles of the other field needs to be negotiated. Access to media may actually mean that institutions are better equipped to achieve certain strategic aims (in case of science, for example, attracting bright students). Media, in that scheme, may provide and amplify that access to the extent that it shares or supports the aims of the institution without losing the potential or possibility of autonomous 'watchdog' journalism when it becomes necessary. The case of ESTCube illustrates nicely the first part of this argument. More cases are needed, however, to confirm whether the latter part holds true as well.

While this paper may give hints of the feedback effects of the mediatization process on media itself, an in-depth analysis of the interaction patterns between journalists and their sources would be needed to provide evidence of such effects. Considering the role that media autonomy plays in enabling media to fulfil several of their crucial societal functions, the question about the presence and impact of mediatization effects on media is increasingly relevant.

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IV

Olesk, A. (2021). The types of visible scientists. *Journal of Science Communication*, 20 (2). https://doi.org/10.22323/2.20020206.

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The types of visible scientists

Arko Olesk

Abstract

We lack a good framework to characterize media-related adaptations of researchers. This paper explores Estonian scientists visible in the media to propose five dimensions to characterize the degree of mediatization of a researcher, and describes two basic types of visible scientists. Representatives of one type ('adapters to media logic') are able to explain the project simply and engagingly in the media, while those of the second type ('adopters of media logic') proactively create media interactions and manage them to achieve strategic aims. The results show how individual actors translate communication objectives into media practices, explaining variabilities in scientists' media presence.

Keywords

Professionalism, professional development and training in science communication; Science and media; Science communication: theory and models

DOI

https://doi.org/10.22323/2.20020206

Submitted: 15th June 2020
Accepted: 23rd December 2020
Published: 22nd March 2021

When Rae Goodell put forward the concept of 'visible scientists' in the 1970s, she had in mind "scientists… visible primarily neither for discoveries, for popularizing, nor for leading the scientific community, but for activities in the tumultuous world of politics and controversy" [Goodell, 1977, p. 6]. Scientists like Carl Sagan or Linus Pauling "used their prominence to draw public attention to their era's pressing science policy issues" [Fahy, 2017, p. 1020] which, according to Goodell, represented a new trend in the relationship between science and the media. The high profile of certain scientists was achieved, Goodell argued, because they were "aggressively taking advantage of the new communications media" [Goodell, 1977, p. 6] and had developed a "remarkable cooperation" and "sophistication" in dealing with the press [Goodell, 1977, pp. 8–9]. In short, "they were uniquely attuned to the needs of the mass media" [Fahy, 2017, p. 1020].

Goodell's observation of the mechanism that produces visibility for scientists has not lost its relevance in the following decades. We have observed media's increasing interest for science stories and controversies within it [Schäfer, 2011], and a strong policy push, both on national and international levels for more and better science communication [Weingart and Joubert, 2019; Trench et al., 2014],

leading to a general expectation that every scientist should actively participate "in the visibility of science by engaging in communication with its diverse publics" [Rödder, 2012, pp. 158–159]. We have seen new forms of public visibility such as celebrity scientists [Fahy, 2015] or social media activity [Ke, Ahn and Sugimoto, 2017; Liang et al., 2014; Shema, Bar-Ilan and Thelwall, 2012].

In Goodell's times, media visibility was often seen as a controversial in the scientific community, perceived as harmful to the credibility and productivity of the researchers [Goodell, 1977]. While the concerns of visibility's possible eroding impact to science are still raised [e.g. Weingart, 2012], achieving and sustaining visibility has now become a common goal, especially for research organizations [Scheu and Olesk, 2018; Kohring et al., 2013].

The change, both in the case of Goodell's policy-oriented visible scientists and the recent expansion of visibility-producing activities, can partly be attributed to the realization that public visibility is a valuable resource. Changes in science, that also kickstarted the science communication movement, have added a number of motives that visibility, especially via media, is supposed to achieve: besides influencing policy, visibility is perceived to helpful for increasing public support and trust for science, influence citizen behaviour, increase public understanding of science; but also bring funding and students [Gregory and Miller, 2000; Kappel and Holmen, 2019; Ruão, Correia Neves and Magalhães, 2015; Weingart and Joubert, 2019].

As a consequence, we have seen that activities within the practice of science communication are increasingly oriented towards achieving media visibility and supported by, for example, media training workshops for researchers or employing an increasing number of communication specialists at research institutions. From a critical perspective, the situation is understood as problematic from two perspectives: first, the activities designed to promote and persuade dominate over activities seeking to educate and inform [Peters, Brossard, de Cheveigné, Dunwoody, Heinrichs et al., 2009; Weingart and Joubert, 2019]. Second, orientation towards media leads to adaptations with media's operating logic, reducing the autonomy of science [Peters, Brossard, de Cheveigné, Dunwoody, Heinrichs et al., 2009; Weingart, 2012].

Other authors [e.g. Besley, 2020; Roberson, 2020], however, argue that we need organizational communication activities and to use the principles of public relations theory and practice to be more effective in science communication, also with the educational aims. This tension calls for a deeper look into the communication motives of scientists and how these reflect in the individual communication practices, including media interactions.

Some authors [Horst, 2013; Väliverronen, 2001] have already mapped the different roles that scientists take in the media, ranging from explainer of their work to lobbying for a particular goal. It is reasonable to think that various goals require different (media) skills to be successfully achieved. Therefore, the signs of diversification of the scientists' position in the science-media relationship invites an updated look at visible scientists and seek for a better understanding of the characteristics of their visibility. Foremost, this paper aims to offer a list of indicators which could be used to evaluate the mediatization pattern of a scientist,

and, thereby, provide a possible tool to detect and analyse variabilities of motives and adaptations in scientists' visibility-driven interactions with the media.

The framework for this analysis is provided by the mediatization approach, a theory that investigates the interdependencies of various social systems (such as science) with media. Its focus on describing societal changes that are initiated by the permeation of media to all areas of modern life makes it helpful in discussing the changes that are taking place in science. The focus on mediatization on the individual level enables to investigate the changes of practices of scientists due to their interaction with mass media channels, and relate this to their media skills and motives of communication.

Visibility is understood in this paper as frequent presence in journalistic mass media, therefore a situation that is a result of mediatization processes or contributes to the mediatization of involved scientists.

This paper uses interviews made with visible scientists in Estonia to answer the following research questions: 1) *What indicators can be used to describe the mediatization characteristics of individual scientists?* and 2) *What types of visible scientists can be constructed using these indicators?*

Indicators of mediatization

Mediatization (also *medialization*) is a theoretical framework discussing the influences of media and communications in other social and cultural domains such as politics or science [Hepp, Hjarvard and Lundby, 2015]. The growing impact of media technologies and mass media systems in our societies creates a *dependence* [Hjarvard, 2013] of culture and society on the media and its formats, leading to transformation of societal institutions [Hjarvard, 2013; Marcinkowski, 2014; Strömbäck, 2008]. The institutional perspective of mediatization describes how "media logic", i.e. the form and formats of communication [Altheide, 2013] is becoming accommodated [Schulz, 2004] into the processes of various societal institutions in response to the perceived role of media in the society, and links these to the long-term cultural and social change that follows such mediated communication [Lundby, 2014].

There have been few attempts to develop a systematic set of indicators to evaluate mediatization. This is mostly due to the dominance of the macro- or meso-level approach in mediatization studies dealing with processes that are not easily operationalizable. Helpful starting points include Jesper Strömbäck's [2008] phases of mediatization. He describes the final phases of mediatization as situations where (political) actors start adapting to media logic, and, finally, the actors adopting media logic to the extent that it becomes internalized to their institutional processes [Strömbäck, 2008].

A more detailed framework to operationalize mediatization was offered by Scheu, Volpers et al. [2014] They investigated how decision makers in research organizations perceive the role of media in research policy and defined three structural levels on which changes take place: constellations of actors, expectations, and interpretations. In detail, mediatization in the constellation of actors takes

place when the position and influences of actors change due to mass media. Changes in structures of expectations might include transformation in formal and informal norms, regulations, organizational structures etc. Finally, adaptations in structures of interpretations include changes in organizations' or individuals' objectives, motives, cognitive and evaluative orientations [Scheu, Volpers et al., 2014, p. 712].

Studies using this framework [Scheu and Olesk, 2018; Scheu, Volpers et al., 2014; Scheu, 2019] have shown that research institutions perceive media to have an increasingly important role in the research policy setting, leading to accommodations in university structure (e.g. expanding public relations offices) and practices (e.g. providing media training for staff) to achieve more public visibility or respond to general mediatization processes in the society. The science decision makers who favour offensive strategies of mediatization to increase their influence among stakeholders also report more extensive structural adaptations within their organizations [Scheu, 2019].

While the institutional factors can contribute to the visibility of individual scientists, they can also work against it, for example as part of a mechanism to protect the values of science [Scheu, 2019]. The tensions that visible scientists perceive about their role expectations have been discussed, among others, by Goodell [1977] and by Rödder [2012]. Therefore, individual factors are relevant in achieving visibility and we require a framework to analyse the factors that lead to mediatization on the micro-level.

One such framework — the model of "mental mediatization" — is proposed [Marcinkowski, 2014], taking politics as an example. According to this model, the experience of the omnipresence of the media triggers changes in the thinking, communicating, and acting of the individuals: politicians experience at first-hand what powers of influence the media can exercise. This experience, coupled with frequent contact with journalists, the persuasions of media advisers and their own extensive media consumption, leads to the development of ideas about how media function [pp. 17–18]. Here, considering the recent intensification of the science-media relationship, the concept of "mental mediatization" allows us to understand (and investigate) mediatization as a phenomenon that is manifesting itself via the perceived understandings of media logic by individuals, and the influence of these perceptions on their actions [Olesk, 2019b].

Already Goodell noted some changes that we now can label as signs of mediatization. As explained by Fahy [2017, p. 1020], Goodell's visible scientists were "controversial and articulate, had a colourful image and had a hot topic that made their work relevant to social concerns… The scientists crafted in part a public image that conformed to these characteristics in order to make themselves more likely to be selected and given prominence by media figures".

In a meta-analysis Peters [2013] shows that most scientists consider visibility in the media important and responding to journalists a professional duty. Several studies on mediatization of science [Olesk, 2019b; Peters, 2013; Rödder, 2009; Rödder and Schäfer, 2010; Scheu, Volpers et al., 2014] have given indications that scientific actors have a perception of a distinct media logic. Other proposed hallmarks, summarized by Rödder and Schäfer [2010], Schäfer [2014] and Rödder [2009]

include promoting research results through press conferences, sometimes even before the official scientific publication, and the proactive use of promotional metaphors such as the 'catastrophe' discourse in climate research. However, as Schäfer [2014] admits, these indicators are often based on extreme or non-routine cases.

The frameworks presented in this section indicate that while the concept of media logic is at the core of mediatization, it leads to specific kinds of adaptions, practices and changes in various social fields and on different levels. Therefore, the need for specific qualitative indicators to describe the mediatization of scientists leads us to the first research question: *What indicators can be used to describe the mediatization characteristics of individual scientists?*

The approach taken to formulate the indicators is guided by the work of Schweitzer [2012]. Working of mediatization of politics, she presents a list of six empirical indicators. These include, among others "the extent to which parties or candidates adopt a journalistic news style to address the public", "the amount by which political messages are triggered by mediatized or staged events in comparison to genuine events", "the extent to which parties' communication revolves around their top candidates, their personalities, and private lives at the expense of other political actors" and "the degree to which parties concentrate in their messages on conflict and criticism rather than on positive self-promotion" [Schweitzer, 2012, p. 285]. This list serves as a model not so much in terms of the proposed indicators themselves (since these represent elements quite specific to politics) but for the way it breaks mediatization down into elements that are possible to evaluate. Combined, these indicators allow characterization of the extent and nature of mediatization of parties or individual candidates.

Scientists in the media — motives and roles

The role of institutional actors such as universities, conferences and journals has become more important [Peters, Brossard, de Cheveigné, Dunwoody, Kallfass et al., 2008; Peters, 2013] and their press releases have considerable influence on media content [Granado, 2011; Weitkamp and Eidsvaag, 2014]. Still, despite increasing mediation between scientist and media, it is the motivation and contribution of the scientists that shapes the fundamental characteristics of science communication.

Studies that have investigated the motives of scientists to engage in public communication reveal a mix of motives, combining objectives related to personal, institutional and public benefits. Often mentioned personal motives include enjoyment and/or a sense of duty or responsibility, increasing the public's interest in, understanding of and enthusiasm for science, and gaining trust [Cerrato et al., 2018; Entradas et al., 2019; Gascoigne and Metcalfe, 1997; Loroño-Leturiondo and Davies, 2018; Martín-Sempere, Garzón-García and Rey-Rocha, 2008; Peters, Brossard, de Cheveigné, Dunwoody, Kallfass et al., 2008; Rose, Markowitz and Brossard, 2020; Sanz Merino and Tarhuni Navarro, 2019]. The works of Besley and colleagues [Besley, Dudo and Yuan, 2018; Besley, O'Hara and Dudo, 2019; Dudo and Besley, 2016] have analysed the predictors of prioritizing between objectives and various tactics used to accomplish them.

At the same time, a number of scholars, starting from Goodell, emphasize the political dimension in science communication, for example in the form of engaging in societal debates and agenda-building [Goodell, 1977; Nisbet and Markowitz, 2015; Scheufele, 2014]. The need to differentiate between the educational and political functions of science communication — both for analytical clarity and practical reasons — was recently highlighted by Weingart and Joubert [2019] although they associate the political motives almost exclusively with institutional actors.

Massimiano Bucchi [1996] has pointed out that in certain situations, usually connected to scientific controversies, scientists start to address the public directly by skipping the usual stages of scientific communication. These situations create a new modality in science communication that is associated with different objectives and tactics compared to the traditional dissemination pathways. Together, these observations illustrate that when conducting analysis on scientists' presence in media, we need to consider the choices made by the actors in terms of objectives and tactics within a specific context — in short, analyse what roles scientists perform in media. Currently, there is no framework that manages to extensively conceptualize the possible roles but a few papers suggest possible role sets that scientists perform in media.

Analysing the media coverage of forest damage in Finland, Väliverronen [2001] defines five roles for scientists as experts in public discourse: populariser, interpreter, adviser/advocate, promoter/manager and critic. A *populariser* presents new research results, *interpreter* discusses new phenomena and problems, *adviser/advocate* makes policy claims or comments on them, *promoter/manager* seeks to legitimize science (e.g. by justifying the use of public funds), and *critic* comments on research results [Väliverronen, 2001]. Researchers interviewed by Väliverronen see themselves usually combining two or three roles, the majority preferring the role of interpreter. The roles of populariser, advocate and critic were next, more or less equally popular [Väliverronen, 2001].

In her interviews with Danish scientists, Horst [2013] identified three different ideal roles that scientists can take when they represent science: Expert, Research Manager, and Guardian of Science. In the first role, scientists primarily represent a scientific field or discipline and communicate scientific facts. In the second role, they explicitly refer to the research organization and make efforts to portray their research organization in a favourable light. In the third role, they represent the institution of science and focus the communication activities on improving the public's understanding of science [Horst, 2013].

The two presented role sets have both their own virtues for analysing scientists in the media. What both show us, moreover, is that there are distinct roles for scientists, each implying "particular notions of quality, audience, motivation, and learning in science communication" [Horst, 2013, p. 758]. Taken from there, we can hypothesize that each role might also require somewhat different adaptations or set of adaptations to media logic, therefore creating a characteristic pattern of mediatization. Once we have identified qualitative indicators to describe the mediatization of scientists, we can start looking at what are the different mediatization patterns among visible scientists and correlate them with perceived roles. This provides us the second research question: *What types of visible scientists can be constructed using these indicators?*

Methods

This paper uses a two-step approach to develop and corroborate the indicators. Both steps employ qualitative semi-structured interviews with researchers: indicators were inductively developed based on the data from the first group; the second group served for corroboration of the indicators and provided data to construct the types of visible scientists.

Following the frameworks presented in the theoretical section, we can understand individual-level mediatization as a combination of media-related mental concepts, attitudes and practices. By evaluating these aspects and their interrelations, as reflected by the respondents, we are able characterize someone's mediatization. This consideration guided the selection of semi-structured interviews as the research method, since this method allows comparison on the participants' responses "while simultaneously seeking to fully understand their unique experiences" [Barlow, 2010, p. 497].

The first group ($n = 8$) consists of members of the group that built and launched the satellite ESTCube-1. This was the first Estonian satellite, it was devised and built by a group of graduate and postgraduate students of Estonian universities under the supervision or a senior researcher [Olesk and Noorma, 2021]. The project achieved high visibility in Estonia, releasing 30 press releases and generating 160 original media items during the course of the project between 2008 in 2015 [Olesk, 2019a]. The nature of media coverage and data gathered with interviews about the media attitudes and practices of the team members support the conclusion that the group became mediatized during the project [Olesk, 2019b; Olesk, 2019a]. For a detailed description of the satellite project and the sample, please see [Olesk and Noorma, 2021; Olesk, 2019b].

The interviews with the group members aimed to understand the nature of their media interactions and the process of mediatization. The interviews focussed on the following topics: description and evaluation of their media interactions during the project, perception of media logic, process of learning the media skills and perception of media's impact on the project. For developing the indicators, I performed coding of the interviews in a two-step process: initial or open coding to broadly identify differences in the media-related attitudes and practices of the respondents, followed by selective or focused coding [Charmaz and Belgrave, 2012], resulting in five indicators (presented in Table 2).

Since ESTCube-1 was not a standard research project, a second group was compiled to corroborate whether the indicators produce meaningful explanations also in another sample. The sample consisted of Estonian scientists ($n = 8$) who can be considered publicly visible. The group included three researchers who have been awarded the Person of the Year recognition by the *Postimees* newspaper and three recent recipients of the award Friend of Science Journalists, awarded by the Estonian Association of Science Journalists.[1] Estonian universities were approached to find out whether they have statistics about their most media-visible researchers — such data existed in one university and the top researcher was included in the sample. In addition, some respondents were selected because of their position: presidents of the Estonian Academy of Sciences and Estonian Young Academy of Sciences. Both organizations have recently made efforts to be publicly

[1] The supervisor of the ESTCube-1 team, interviewed in the first group, has also received both the Person of the Year recognition and the Friend of Science Journalists award.

Table 1. Interviewed visible scientists.

Interview no	*Research field*	*Position*	*Recognition/visible project*
1	Engineering	Professor	Friend of Science Journalists
2	Bird ecology	Researcher/department communication specialist	Most productive author of the university
3	Genetics	Senior researcher	Estonian Biobank
4	Molecular biology	Professor	Friend of Science Journalists
5	Conservation biology	Senior researcher	Person of the Year
6	Genetics	Professor	Person of the Year, Estonian Biobank
7	Physics	Senior Researcher	Young Academy of Sciences
8	Physical oceanography	Professor	Estonian Academy of Sciences, Friend of Science Journalists, Person of the Year

visible. Finally, the sample included two leading representatives from the Estonian Biobank. The project has a long history of public engagement and, at the time of the interview, was conducting a national campaign to recruit 100,000 gene donors. Some respondents featured simultaneously in several categories (see Table 1). The gender balance in the second group was 6:2 in favour of men, while the first group was all-male. Studies on gender balance in Estonian media [e.g. Org, 2016; Pärnapuu et al., 2017; Pilvre, 2012] indicate that this ratio reflects the general visibility of women experts in the media discourse. Among the nine recipients of the Friend of Science Journalists award, six have been male, whereas only two women have been individually received the Person of the Year title, awarded annually since 1997.

The interviews with the visible scientists were structured according to the five dimensions identified with the previous group but to allow the possibility of new indicators being found, the interviews also included open-ended questions [Roulston, 2008] about the respondents' perspective about and experiences with media. The author analysed the interview transcripts deductively based on the five dimensions and did an inductive analysis to explore possible additional important codes.

Interviews with ESTCube-1 team members ranged from 24 to 95 minutes, lasting 54 minutes on average. Interviews with visible scientists ranged from 49 to 71 minutes, lasting 58 minutes on average. The interviews were held in Estonian (except for one in English), fully transcribed, either by the author or by a service provider, and manually coded by the author. Presented quotes were translated into English after being selected to the article.

Results

Interviewed members of the ESTCube-1 team all shared an understanding that media visibility is relevant for the project. At the same time, despite the rather small number of respondents, the group turned out to be internally diverse enough

Table 2. Five dimensions that provide indicators for evaluating the mediatization of scientists.

Dimension	*Indicator description*
Communication as a responsibility	The extent to which the scientists see public communication as part of their professional responsibility
Awareness of media logic	The extent to which the scientists express awareness of media logic and feel confident in using journalistic news style to address the public
Mastering media logic	The extent to which the scientists feel confident in mastering media logic and using it to trigger media coverage (via press conferences, press releases, directly contacting journalists) or introduce angles relevant for them
Purposeful use of media	The extent to which the scientists see media as a tool for achieving their scientific or non-scientific aims
Institutionalization of communication activities	The extent to which the communication activities in the research group/organization have been institutionalized within the professional activities of the scientist

in their media-related attitudes and practices to allow the development of an analytical framework.

The coding resulted in identification of five dimensions that provide indicators for evaluating the mediatization of scientists (see Table 2). The framework combines insights from mental mediatization framework [Marcinkowski, 2014] about the role of scientists' perception of media logic and media impact in shaping their practices, from the framework of structural change [Scheu, Volpers et al., 2014] about the role of norms and cognitive evaluations in guiding the adaptations to media logic, and from the phases of mediatization [Strömbäck, 2008] about the level of intensity regarding adaptations to media logic. The general design of the framework is based on Schweitzer [2012].

The first dimension — the extent to which the scientists see public communication as part of their professional responsibility — covers, for example, the readiness to incorporate public communication into their professional activities. In this group, some respondents were more ready to devote their resources for communication, others saw it as secondary in comparison with research.

Perceiving and using media logic can be described via expressed attitudes and practices such as, among others, knowledge about how to behave in an interview, understanding that journalists work on tight deadlines and make major simplifications, thinking in terms of target groups and messages, issuing press releases and initiating media coverage. Two separate indicators are proposed for media logic to distinguish between different types of involvement in media content production. One of them has researchers in a *responsive* position, i.e. deals with how well they are able to handle interactions with journalists. This does not only include the ability to respond to questions and explain the science but also interactions and routines during the whole process, from preparation to reflecting on the outcome.

For example, preparation for the media interactions is described as an active process that enables better control of the communication. The regular routines

include asking the journalist for background information about the upcoming interview (length, channel, format etc.), requesting the questions upfront by e-mail, and requesting to have a look at the final draft of the article (in case of print media).

The other indicator evaluates the *proactive* capabilities of the researchers, e.g. activities that are related to promoting their work or efforts of agenda-setting. In this dimension, the researchers have a stronger agency and can become equal — or even more powerful — actors than the journalists. Proactivity also means initiating media coverage and choosing the device to provide most visibility. ESTCube-1 project supervisor explains his strategy:

> *"I have learned that a press release is not the best device… [When preparing to release some news] I would make agreements with newspapers that are ready to put the news on their front page or write a longer article… I would make separate deals, give them material so by the moment that we issue a press release, certain channels are professionally prepared and ready to gain a certain advantage. I will help them to gain this advantage. They will have an exclusive material. For others, it is nice if they pick up the press release but there is no harm if they don't."* (Group 1, interview 1)

The fourth dimension discusses the perceived benefits of visibility and researchers' motives for media interactions. ESTCube-1 team members gave various responses to the question what aims do they feel media coverage helps them to achieve. These range from specific benefits to the project to wider societal aims: introducing the project to the general public, popularizing STEM subjects (science, technology, engineering and maths), increasing public support for science, ensuring political support for space sciences or attracting students to the project and to the university.

The final indicator deals with the extent of institutionalization of public communication. All systematic media activities of the ESTCube team, ranging from managing web page and posting to social media to writing press releases remained voluntary. In retrospect, some team members expressed opinion that communication would have benefitted if the communication duties had been clearly assigned to some team members or a special person engaged with these tasks.

For the ESTCube-1 group, we can conclude that the five proposed indicators reflect functional differences in the respondents' relationship with the media and help to evaluate the level of mediatization. The next step was to test whether the developed indicators perform similarly when applied on a wider, more diverse group of visible researchers.

Interviews with the second group of respondents, indeed, confirmed that the indicators enable seeing and describing variability in the mediatization patterns of (visible) scientists. No need for adjusting or adding indicators was identified. The analysis process leading to the patterns is exemplified on Figure 1 (based on the indicator "Purposeful use of media" and using illustrative quotes from respondents in the second group, visible scientists). For each indicator, the responses of interviewees of the second group were evaluated, compared to each other and situated on the scale that reflects the extent of mediatization, either concerning their mental concepts about media or self-described adaptations to media logic.

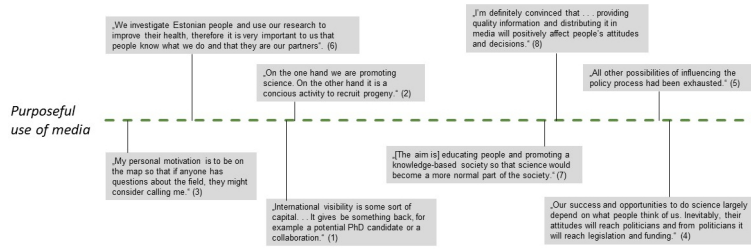

Figure 1. Example of indicator analysis in the process of creating patterns of mediatization. Quotes are from the second group of interviewees (visible scientists).

Table 3. Basic typology of mediatized scientists.

Dimension	*Adapters to media logic*	*Adopters of media logic*
Communication as a responsibility	See it as important but secondary to their scientific work.	See it equally important to their scientific work.
Awareness of media logic	Are able to explain their work in simple terms and feel confident giving interviews. Criticize journalists' routines.	Are able to understand and accept the journalists' work logic, and express themselves in journalistic news style.
Mastering media logic	Are not familiar with news production practices; write an occasional press release; otherwise do not initiate media coverage.	Contact journalists proactively and manage to 'sell' stories and angles to them.
Purposeful use of media	See media coverage as benefitting the current project or result (getting attention, increasing awareness about issue etc.).	Have more strategic aims (wider benefits to science, economy etc.) and think in terms of *target groups* and *messages*.
Institutionalization of communication activities	Perform communication activities on ad hoc basis.	Conduct communication activities systematically and follow a strategic plan, integrating public communication into the professional activities of the scientist.

While each respondent had a distinct pattern of mediatization and did not fall neatly into the identified types, two clusters emerged. Roughly, these were located at the — if described in a very simplified way — low- and high-level ends of the dimensions. Based on the clusters, two basic types of mediatized scientists could be developed — labelled *adapters to media logic* and *adopters of media logic*. Table 3 provides an overview of the characteristics of both types.

The two types both represent scientists who might be considered good science communicators by the public. The types, however, reflect varying extent of media-related adaptations of the scientist, associated with different objectives that

researchers assign to their communication activities and ways in which the communication is executed. The adapters know how to handle interview situations and are able to explain their work in lay-person's terms. At the same time, they see the aim of the media interactions mostly as explaining their research and place great emphasis on the correct representation of their work. They prefer to have communication professionals involved with the project allowing them to concentrate on their research.

The second type is labelled adopters because they have internalized media handling skills and uses these consciously to manage media attention. The adopters acknowledge and explicitly express the instrumental nature of their communication activities: interaction with media is not only seen as promoting their own project by also as a device to gain public support, inspire young people or convince policy makers. What characterizes interaction with media in this discourse is not as much focus on explaining scientific facts or results but promoting a more general agenda. Hence, the main concern is not about media getting the facts right but the senders getting their message across. The discourse displays itself also in the language of the interviewees: they use terms like "target group" and "message" which are characteristic to the field of public relations. This reveals that the interviewees perceive media as a powerful actor in the society, capable of influencing other actors.

The placement of the respondents in types rather seems to correlate with their *pathway to visibility*, i.e. the usual mechanism by which media presence is created. For example, the respondents who can be described as adapters, described that the interaction is usually initiated by the journalist, calling the researcher and asking to comment on something in their expert field. Therefore, much of the visibility can be considered media-driven. These respondents see their role in the media mostly as 'popularizers' or 'interpreters' (to use Väliverronen's terms).

The respondents who displayed higher level of mediatization ('adopters') were more likely to be leading an institution or major project, or be public champions of a specific topic. While their visibility also included the media-driven component, they described significant either personal or institutional efforts to gain media visibility and have adopted media practices that support their strategic objectives (see quote below). Therefore, we can describe their visibility as position-driven or strategic goal driven.

> *"[Short] interviews are a very bad journalistic format for a scientist. I use them more or less consciously to create interest for a longer contact. So I give this 1-minute interview but my real goal could be that we get together [with the journalist] and talk about the topic more in-depth… I have had my reservations about journalistic interest for my person. So far, I have almost always managed to make [person interviews] work for [introducing the scientific] topic."* (Group 2, interview 5)

We also see that, depending on the situation, scientists can switch between the types, adopting a proactive role for one project or topic and remaining responsive for another. The motivations behind such visibility management behaviour present a relevant topic for further studies.

Discussion

Stig Hjarvard [2014, p. 202] has defined mediatization as "institutionalization of new patterns of social interaction". Several frameworks have been proposed for the identification and characterization of these patterns. However, none of these seems to work well in the micro-level context of mediatization of scientists, prompting me to propose a new one. Evaluating the level of mediatization on each of these five functionally different dimensions gives us the mediatization pattern of the individual researcher. The individual patterns lead the way for defining basic types of visible scientists.

In the context of public communication of science and technology, the patterns of mediatization and types of visible scientists are most relevant for understanding and investigating variabilities in scientists' media presence. They link the *why?* and the *how?* of science communication: mediatization patterns and visibility types help to see how the individual actors translate communication objectives and aims into media practices. These results help to explain the roles that both Horst [2013] and Väliverronen [2001] have found in their media analysis, support the move towards creating a more complete catalogue of roles that scientists fulfil in media, and invite for a discussion about the most relevant roles and skills required to achieve the various objectives of science communication.

Such discussion is relevant because many more pathways to visibility have become possible after Goodell first wrote about visible scientists. The understanding of these pathways to visibility and the factors that shape them, from journalistic practices to scientists' motives and skills, should be a necessary component in all current discussions related to science in media.

At the same time, there are still tensions in the scientific community about what constitutes acceptable visibility [Rödder, 2012], whether all motives support the mission of science communication [Weingart and Joubert, 2019] or whether and how a close relationship with the media can threaten the credibility or core values of science [Weingart, 2012]. The indicators of mediatization and the visibility types can be useful tools both for the critical approach for evaluating the positions that scientists have in the media arena and uncovering micro-level processes that lead to institutional change, and for the practice of science communication by suggesting possible visibility managing practices that provide the greatest benefits for the public and science as an institution.

Media-related learning outcomes feature in many science communication training programs [Baram-Tsabari and Lewenstein, 2017]. A better understanding of the attitudes, skills and practices related to individual-level mediatization can also help to design and evaluate the impact of science communication training activities. The two basic types of mediatized (or visible) scientists proposed in this paper is a distinction such programs should especially take into account.

Given the small sample and the focus on scientists who are already widely visible, this paper remains an exploratory investigation on the variabilities in visibility. To confirm the validity of the framework, studies in other countries would be required, or studies that include a greater variability of researchers in terms of their visibility and media experience. Investigating the pathways to visibility is a promising avenue for further research.

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How to cite

Olesk, A. (2021). 'The types of visible scientists'. *JCOM* 20 (02), A06.
https://doi.org/10.22323/2.20020206.

ISSN 1824-2049. Published by SISSA Medialab. jcom.sissa.it

KOKKUVÕTE

TEADLASTE MEEDIASTUMINE: PROTSESS, INDIKAATORID, MÕJU

Teadlaste esinemine meedias on kahe poolusega teema. Ühest küljest on ühiskondadel selge ootus, et teadlased oma töö tulemusi ja ekspertteadmisi rohkem avalikkusega jagaks, aidates nii tõsta teaduse ühiskondlikku mõju ning legitiimsust. Teaduse ja teadlaste nähtavuse suurendamisse meedias on viimastel aastatel ka palju panustatud, näiteks ülikoolide poolt või riiklikke programmidega (Eestis TeaMe+). Teiselt küljest toob intensiivne läbikäimine meediaga kaasa ohu, et nähtavuse saavutamiseks ja hoidmiseks vajalikud kohastumused hakkavad domineerima teaduse seniste väärtuste ja kvaliteedikriteeriumite üle (Weingart, 2012).

Seda, milliseid kohastumusi ja mis määral ühiskondlikud tegutsejad (sotsiaalsetest institutsioonidest konkreetsete organisatsioonide ja üksikisikuteni) meediasuhtluse nimel teevad, saab analüüsida meediastumise raamistikuga. Lähtudes Couldry ja Heppi määratlusest, on meediastumise lähenemise eesmärk kriitiliselt analüüsida ühelt poolt meedias ja kommunikatsioonis ja teiselt poolt kultuuris ja ühiskonnas aset leidvate muutuste omavahelisi suhteid (Couldry & Hepp, 2013, lk 197).

Selles doktoritöös kasutatud institutsionaalne lähenemine näeb ühe keskse seosena ühiskondlike institutsioonide (nt teadus, sport, religioon, haridus) kohanemist meedialoogika reeglitega, mille tulemusel kinnistuvad uued sotsiaalse suhtluse mustrid (Hjarvard, 2014). Toetudes Bourdieu'le väidab Hjarvard, et selle tulemusel kahaneb meedialoogikaga kohaneva institutsiooni autonoomia (Hjarvard, 2013) – mida rohkem, seda tugevamalt on institutsioon meediastunud. Teised autorid, näiteks Marcinkowski ja Steiner (2009) aga ei leia, et meediastumine on tingimata nullsummamäng. Nende sõnul ei ole kohastumine meedialoogikaga alati meedia poolt teistele peale surutud, vaid institutsioonid algatavad seda ka ise, nähes meedianähtavuses peituvaid võimalusi. Seega on meediastumise tulemusena võimalikud ka vastastikku kasulikud suhted meedia ja institutsiooni vahel ning tegutseja vajaliku agentsuse säilimine.

Teadust on üldiselt peetud meediastumisele vähem vastuvõtlikuks kui paljusid teisi ühiskondlikke institutsioone (Rödder & Schäfer, 2010), ent peamise tunnusena on välja toodud ülikoolide järjest aktiivsemat turunduskultuuri (vt nt Väliverronen, 2021). Samuti on meediastumist nähtud tavapäratute teadussündmuste juures, mida iseloomustab pressikonverentside kasutamine ning teadustulemuste toomine avalikkuseni enne nende ilmumist teadusajakirjades (Rödder, 2009a), samuti harjumuspärasest intensiivsem, mitmehäälsem ja vastuolusid rõhutavam meediakajastus.

Tavapärases teadlaste ja ajakirjanike suhtlemise mustris on teadusajakirjanikke kirjeldatud traditsiooniliselt teaduse suhtes soosivana (Hansen, 2009; Nelkin, 1995) ning teadlasi kahetiselt meelestatuna - küll tunnistatakse avaliku kommunikatsiooni vajalikkust, ent kehtestatakse kogukonnas teatud kirjutamata reeglid, milline

meediasuhtlus on aktsepteeritav (Goodell, 1977; Rödder, 2012; Searle, 2013). Seejuures on alati olnud ka neid reegleid rikkuvaid teadlasi, nn meedias nähtavaid teadlasi, kelle motiive ja tegutsemispraktikaid on pikemalt analüüsinud Goodell (1977).

Muutused nii teaduses kui ka ajakirjanduses, mis on neid mustreid ümber kujundamas, hõlmavad peamiselt teadusvaldkonna kommunikatsioonivõimekuse kasvu ja ajakirjanduse nõrgenemist. Ülikoolid jt teadusasutused on kerkinud domineerivaks sisuloojaks (Marcinkowski & Kohring, 2014; Vogler & Schäfer, 2020), sest tajuvad avalikkuse tähelepanus olulist vahendit oma strateegiliste eesmärkide saavutamiseks. Kuna teadusasutuste kohandumiste (näiteks kommunikatsiooniosakondade laiendamise, teadlaste koolitamise või meediasisu tootmise) aluseks on soov saada rohkem avalikku nähtavust, liigitub see meediastumiseks.

Kuigi organisatsiooni eesmärgid võivad suunata ka seal töötavate teadlaste kommunikatsioonitegevusi, näitavad senised uuringud pigem, et teadlaste või teadusrühmade motiivid on autonoomsed, ka siis, kui need mingis osas organisatsiooni omadega kattuvad. Individuaalsete eesmärkide seas kohtab sageli soovi suurendada teadustöö legitiimsust ja usaldust teaduse vastu, tõsta avalikkuse huvi teaduse vastu ning arusaamist sellest, samuti isiklikku naudingut kommunikatsioonist (Fiske & Dupree, 2014; Martín-Sempere et al., 2008; Peters et al., 2008; Rose et al., 2020). Konkreetseid eesmärke, mis väljenduvad võetavates rollides, kohtab ka teadlaste meediaesinemistes. Selliseid rolle on kaardistanud Väliverronen (2001) ja Horst (2014), tuues teiste seas välja selgitaja, teema eeskõneleja, asutuse eestkõneleja või kriitiku rollid.

Võib eeldada, et seatud eesmärkide saavutamise edukus meedias sõltub teadlase oskustest ajakirjanikuga suhelda ja oma sõnumit edasi anda. Teisisõnu, meedialoogika mõistmisest ja oma praktikate sellega kohandamisest. Seejuures ei pea kohastumusi suunama mitte ainult meedialoogika nii, nagu see ajakirjanike töös avaldub, vaid isegi olulisem on tajutud arusaam sellest, mis on meedianähtavuse saavutamiseks tarvilik (Marcinkowski (2014) nimetab seda „mentaalseks meediastumiseks“). Seega võivad nende kujutluste alusel ette võetud kohastumused olla tegelikkuses eri tõhususega.

Samuti võib eeldada, et eri eesmärgid ja rollid eeldavad erisuguseid kohastumusi ehk iseloomulikku meediastumise mustrit. Seetõttu on nii meediapildis kohatavate teadlastevaheliste erisuste mõistmiseks kui ka teadlaste meediasuhtluseks paremaks ettevalmistamiseks tarvilik mõista meediastumise mustreid ja selle aluseks olevaid protsesse. Just seda püüab see doktoritöö saavutada.

Doktoritöö keskmes on kolm peamist uurimisküsimust:

1) Millised elemendid toetasid uuritud teadlaste meediastumise protsessi?
2) Milliste indikaatoritega saab kirjeldada teadlase meediastumist?

3) Millised mõjud kaasnevad meediaga seotud individuaalsete ja kollektiivsete kohastumustega?

Vastuste leidmiseks tegin süvaintervjuud 22 Eesti teadlasega, keda võib hinnata meediastumisprotsesside mõjuväljas olevaks. Nende seas oli kolm peamist rühma: teadusvaldkonna otsustajad (nt ülikoolide juhtkonna liikmed), Eesti esimese satelliidi ESTCube-1 valmistanud rühma liikmed ja muud meedias nähtavad teadlased (nt ajakirjanduselt auhindu pälvinud teadlased). Lähema vaatluse all on ESTCube-1, mida saab hinnata intensiivse meediastumise juhtumina. Alustades ei olnud rühmal mingit meediakogemust, ent kiirelt saavutati meedias tähelepanuväärne nähtavus, tänu sellele on meediastumise protsess olnud nende puhul eriti hästi jälgitav. Olin ka ise ajakirjanikuna selle osaline, suheldes rühmaga lähemalt nii ajaleheartiklite jaoks kui ka arutades ühiselt ajakirjandusega suhtlemise probleeme. Samuti osalesid mõned rühma liikmed minu läbi viidud kommunikatsioonikoolitusel.

Tulemused näitavad, et ESTCube'i meeskonna meediaoskuste kujunemist toetasid tugevalt kolm tegurit: projekti juhi aktiivne suunamine, liikmete osalemine meediakoolitusel ja meediakogemuste ühine arutelu. Nende koosmõjus kujunes meeskonnal ühine arusaam meedianähtavuse olulisest ning leiti võtted ja kohastumused, mille abil tagada enda sõnumi domineerimine meediakajastuses. Need liikmed, kes väljendasid meediasuhtluse eesmärgina strateegilisemat motiivi (nt teaduse maine tõstmine), näitasid ka rohkem kohastumusi ehk intensiivsemat meediastumise taset.

ESTCube'i meeskonnaliikmete meediapraktikate vahel täheldatud erinevused aitasid välja töötada viis indikaatorit, mille abil meediastumist hinnata. Hinnates teadlaste arusaamu ja tegevusi viie mõõtme osas – kommunikatsiooni tajumine vastutusena, teadlikkus meedialoogikast, meedialoogika valdamine, meedia sihipärane kasutamine ning kommunikatsioonitegevuste institutsionaliseeritus – saame selle teadlase iseloomuliku meediastumise mustri.

Töös joonistan mustrite põhjal välja kaks nähtava teadlase tüüpi, ilmestamaks, kuidas muster saab välja tuua funktsionaalseid, võetud või saadud rollidest tulenevaid erinevusi meediakäitumises. Ühe tüübi esindaja on meedialoogikaga tuttav ja suudab oma teemat huvitavalt selgitada, ent ei mõista ajakirjanike tegevusloogikat täielikult ja eelistab piirduda ajakirjanike päringutele vastamise ning oma valdkonnast või projektist kõnelemisega. Teise tüübi esindaja peab avalikkuse suhtlust sama tähtsaks kui teadustööd ning kasutab meediat sihipäraselt teatud strateegiliste eesmärkide saavutamiseks. Tema meediakohastumuste arsenal on laiem ning ta algatab ise meediakajastusi.

ESTCube-1 meediakajastuse analüüs näitab, et satelliidi meeskond oli meedias pildil kogu projekti kestuse, välja arvatud perioodil, mil nad tegelesid orbiidil ilmnenud probleemide lahendamisega. Kajastus oli läbivalt positiivne ja artiklite allikad olid kas ESTCube'i meeskonna liikmed või nende poolt vahendatud väliseksperdid. Projekti vältel jõudis meediani ka 30 pressiteadet, milles satelliidi meeskond

püüdis esile tuua projekti teisi tahke peale teadusliku ja insener-tehnilise. Nii oli pressiteadetes esile toomise sageduselt teisel kohal projekti hariduslik eesmärk, viidates selle aspekti tähtsusele projekti meeskonna jaoks. Ka meediakajastuse analüüsis oli näha, et ajakirjanikud võtsid selle aspekti omaks ja tõid seda oma kajastustes esile.

Meediakajastuse analüüsi, uuringuintervjuude ja isikliku kogemuse põhjal saab väita, et ESTCube'i meeskonna meediastumine aitas oluliselt kaasa meediakajastuse mahule ja kujundas selle iseloomu, minimeerides kriitilisi hääli ning aidates kajastusse tuua vaatenurki, mida ajakirjanikud muidu poleks ehk käsitlenud.

Nii teadusvaldkonna otsustajatele kui ka ESTCube'i teadlastele osutus keskseks eesmärgiks teaduse ja enda projekti positiivse kuvandi hoidmine meedias, mida nähti olulise vahendina, mille abil kujundada suhteid teiste ühiskondlike tegutsejatega (nt poliitikud, noored). Selle saavutamiseks nähti ühe tõhusama viisina isiklike kontaktide loomist ajakirjanikega.

Meediastumise mõjud selle osalistele on seega mitmetahulised. Kuigi senine kirjandus on sageli esile toonud meediastumises peituvad ohte teadusele, ei tajunud siin töös intervjueeritud teadlased neid riske, vaid tõid pigem esile peituvaid võimalusi. Eelkõige nähakse, et meediaoskused ning meedialoogikaga kohandumine aitab tugevdada isiku, organisatsiooni või laiemalt valdkonna positsiooni ühiskonnas ja suhetes teiste ühiskondlike tegutsejatega. Lisaks saab väita, et teatud kohastumused ning institutsionaliseerunud suhtlusmustrid toetavad avaliku suhtluse ja teaduse selgitamise oskusi ja on seega avalikkuse huvides, aidates saavutada teaduskommunikatsiooni eesmärke.

Teisalt suurendavad meediakohastumused teadustegutsejate võimekust suunata meedia sisu ja rõhuasetusi. Mõned Goodelli (1977) kirjeldatud teadlased kasutasid oma meedipositsiooni ära teatud ideede levitamiseks, millele teaduskogukonnas polnud piisavat toetust. Teadlaste ja teadusasutuste meediastumine võib seega teatud tingimustel kahandada ajakirjanike autonoomiat, eriti kui seda soosivad ka teised suundumused meedias.

Kokkuvõttes, doktoritöö näitab, kuidas meediastumine väljendub indiviidide ja teadusrühmade tasandil ning toob uudsena esile, et see võib esineda sõltumatult organisatsiooni tasandi protsessidest ja olla tavapärase teadustegevuse osa. Töö pakub välja raamistiku, mille abil hinnata mikrotasandi meediastumist ja näha eri meediastumise mustreid. Töö tulemused viitavad, et need mustrid vastavad meedia ökosüsteemis asuvatele funktsionaalsetele niššidele, mida teadlased saavad asustada, täites eri rolle. Selliste rollide kaardistamine ning sellega seonduvate meediapraktikate täpsem analüüs on üks edasisi uurimissuundi, mida töö soovitab.

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