



Scientific Communication Observed with Social Systems Theory. An Introduction and Outlook to Pure Science for Society

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Abstract

In this article, we introduce the reader to a social systems-theoretical concept of science, with particular emphasis on the role of theorising within a functionally differentiated society. Six cases are presented that demonstrate how social systems theory serves as both theory and method, thereby offering an insightful super-theoretical framework relevant to both conceptual and empirical studies. We conclude that social systems theory facilitates the pursuit of science for science's sake by effectively challenging persistent self-confusions of society with politics or any other subsystem of society. As a result, the artificial distinction between science for the sake of science and science for the sake of society is overcome, and science for sake of society simply represents a return of science to its own function.

Keywords Social systems theory · Functional differentiation · Science · Grand challenges

Introduction

Science is a dynamic social system. New scientific topics and fields emerge from the system's continuous observations of society, its environment, and science itself. Reflection on scientific communication as both self- and hetero-referential is thus essential to science and

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to the reproduction of its code, true/false. But science is by no means unchallenged as the system devoted to truth. During the COVID-19 crisis, science has seen its monopoly on the definition of truth being disputed, as various claims on the reliability and trustworthiness of, for example, COVID-19 vaccines have been discussed in public debates defined by power struggles over ‘the truth’ and the use labels such as ‘fake news’ as a strategy for epistemic discreditation (Clausen 2022; Žažar, 2022). At the same time, political actors have as often repurposed scientific knowledge for the legitimation of drastic political decisions as they have changed them (Roth 2021; Esfeld 2022; Kuhbänder et al., 2022; Laursen et al. 2023; Roth et al. 2024). Moreover, political decision-makers have presumed to judge what science is and is not, thus causing symptoms of a great irritation of the scientific by the political function system (Zazar and Roth 2024). The COVID-19 pandemic thereby illustrates a broader trend to substantial challenges or outright dismissals of scientific truths, thus seemingly turning them into a matter of opinion.

But this is not the only challenge science faces today. Throughout the world, a perceived commodification or financialization of science (Alvesson et al. 2022; Jemielniak and Greenwood 2015) is affecting not only employment prospects, but also personal and institutional research agendas and publication strategies. At the same time, topics such as climate crises, social inequality, gender, identity, and race have made some scholars pursue goals that rather appear political than scientific (Roth, 2023; Roth et al. 2023). A growing proportion of ostensibly scientific communication is thus undertaken with motives other than purely scientific ones. Should science embrace these tendencies and become activist like some scholars seem to argue with regard to these issues? Or should researchers strive at abstaining from any form of non-scientific communication? What about the role and prospects of the not always peaceful co-existence of science and other function systems in institutions of higher education?

The role of institutions of higher education, too, is changing in the 21st century. Shall universities continue to pursue knowledge for the sake of knowledge, or is it only fair to accept that those who pay for research have some form of influence on the topics and scope of the agendas? Is science a public or private good? Can the truth established by scholars only be challenge by other scholars following the century-old tradition of exchanging opinions via scientific publications? Or should scholars accept that established knowledge and dogmas may also be challenged in the mass-media?

Against the backdrop of these and similar questions, science is forced to reflect upon the criteria applied in defining what can or must be observed as true or false knowledge. A central part of scientific communication is therefore constituted theoretical and methodological challenges. Does the digitalization of society pose new ontological and epistemological challenges or opportunities to science (Roth 2019)? Does the possibility of working with ‘big data’-size survey dataset provide new grounds for knowledge and hence new philosophical issues (Kitchin 2014)? Or can these new forms of data easily be handled within existing theoretical and methodological positions, including social systems theory in the tradition of Luhmann (1995a, 2012, 2013)?

Science in Context the of a Functionally Differentiated Society

The over-identification we witnessed during the coronavirus crisis of science with few of its branches, combined with politically motivated cherry-picking of those simulations and studies that were presented as “the science” and amplified by the mass media, is in sharp contrast with a social systems-theoretical view of science and its function for society. According to Luhmann (1982a, b, 1994, 1995b), contemporary society emerges as polycentric. This is to say that this society lacks a singular central authority, overarching domain, or pre-dominant function system, akin to the dominance religion purportedly held during medieval epochs. By contrast, modern society is held to be defined by functional differentiation (Gagalyuk et al. 2018; Valentinov 2022; Valentinov et al. 2017), and thus by the co-existence of operationally independent function systems such as, inter alia, politics, economy, science, religion, health, or mass media. Each function system performs a distinct function that remains exclusive to it, incapable of being replicated by any other system. Politics cannot engage in scientific pursuits, religion cannot replicate artistic endeavours, and the economy cannot attend to matters of health. Consequently, direct intervention from one system into another is non-existent.

Moreover, these systems are not only operationally closed in the aforementioned sense, but also, by default, incommensurable. Thus, each system therefore possesses, in principle, equal societal value, and yet it is precisely this absence of predetermined relative values among these systems that forms the fundamental condition enabling various societal subsystems to assign distinct values to each function system (as expounded by Roth et al. 2019).

It is hence against this at first somewhat paradoxical backdrop that the function systems may be observed to be of different value in specific periods of social evolution or for specific subsystems of society (see Fig. 1).

As is visible in Fig. 1, the relative importance of science—as expressed in terms of the relative frequency of scientific keywords found in the English language Google Books corpus for the period between the years 1800 and 2000—has been comparably low throughout the 19th century and increased considerably only as late as in the second half of the 20th

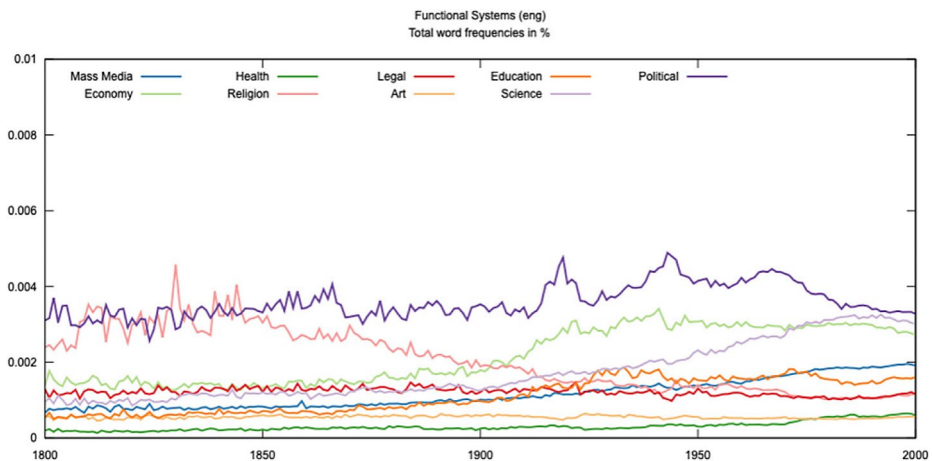


Fig. 1 Combined occurrence frequencies of all “function system”-specific keywords as found in the English language Google Books corpus (1800–2000).(source: Roth et al. 2019, p.4)

century. By the end of this century, however, science has outperformed economy and is second to politics by only a small margin. Recent research yet unpublished at the time of writing suggests that science has outperformed politics in the course of the first two post-millennium decades.

In any case, the idea that the post-WWII period has been shaped particularly by the interplay of politics, science, and economy as the most dominant function systems aligns well with so-called triple helix models of innovation and development (Etzkowitz and Leydesdorff 1995; Leydesdorff 2000; Etzkowitz and Dzisah 2008). The circumstance that the present contributions to this special issue, too, dedicate a considerable amount of attention to the interfaces of science, politics, and economy, however, does not prevent the analysis of different or more complex constellations (Leydesdorff 2012).

Six Systems-theoretical Observations of Scientific Communication

The six articles included in the special issue demonstrate how social systems theory can act as both theory and method (Roth et al. 2021), and thus provide a heuristically fruitful super-theoretical framework pertinent for both conceptual and empirical studies, aiming at understanding transmutation of semantics of science system, changes of its internal dynamics, as well as complex interrelation of science to other functional systems (mass media, politics, economy, etc.) at societal, organizational and even individual level.

In his article “Truth tables, true distinctions. Paradoxes of the source code of science”, *Steffen Roth* (2024) draws on works by Niklas Luhmann and George Spencer Brown to discuss the paradoxical nature of scientific observation. Roth starts from the overarching paradox of observation, defined as the concurrent drawing of a distinction and indication of one of its sides. Scientific observation is then introduced as a special case of this inherently paradoxical operation as science is concerned with the drawing of a distinction between true and untrue distinctions. This creates a paradox because, on the one hand, there is no observation without the drawing of a true distinction, that is a distinction that effectively splits the world into two mutually exclusive and collectively exhaustive sides. On the other hand, the distinction between true and false distinctions “is the form of modern science – that is, the difference made by the fact that science exists” (Luhmann, p. 17). Roth maintains and manages this paradox by arguing and demonstrating that observations of false distinctions actually reveal an underlying fusion of two true distinctions. By translating one false distinction into two true ones, one paradox is resolved at the expense of the emergence of another one. Theories then appear as programmes guiding the transition between paradoxes. This perspective allows for a metatheoretical management or operation of paradoxes in terms of a cascading or substitution of logic gates in circuit design. Roth insists that his approach remains unpartisan regarding the observation of particular distinctions as true or untrue while being capable to accommodate any distinctions, making it compatible with all existing paradigms and theories of management, organization, and society.

Kosuke Sakai's (2024) article, “Advice as a form of structural coupling: Intersystem organizations and scientific communication in the Japanese Response to COVID-19,” delves into the realm of scientific discourse amidst recent pandemics, with a particular emphasis on the interplay between science and politics. The examination revolves around the concept of structural (and organizational) couplings, wherein the pivotal role of advice as a bridge

between the two systems is highlighted. The core of the article presents a detailed case study of the numerous expert advisory bodies established in Japan during the onset of the COVID-19 pandemic in 2020. Through concrete examples, the author dissects the intricate relationship between these two functional systems, characterized by often ambiguous boundaries. The advisory boards were tasked with offering evidence-based recommendations to guide political decision-making, yet instances of their politicization surface when members overstep their expertise or assume a narrow role in shaping policy, sometimes even shouldering political responsibilities. Conversely, politicians occasionally intervened in advisory suggestions or made decisions devoid of scientific basis. Sakai's work underscores the heuristic potential of applying Luhmanian theoretical frameworks to unravel the nexus of science and politics, offering a benchmark for similar empirical inquiries given the global proliferation of advisory boards during the COVID-19 pandemic. It advances our comprehension of the intricate interplay between these functional systems, prompting a deeper examination. The article concludes with pertinent questions regarding the selection of experts for advisory boards and the process of curating scientific knowledge within these organizations.

The article authored by *Egon Noe and Hugo F. Alrøe (2024)*, titled "Research Centers, Scientific Freedom, and the Jester's Paradox," presents a detailed and thought-provoking analysis of the multifaceted challenges that confront research centres in their pursuit of scientific integrity. With a comprehensive exploration into the intricacies of organizational structures, funding mechanisms, and societal impact, the authors illuminate the inherent contradictions inherent within these institutions. Notably, the authors unpack the delicate balance between striving for scientific autonomy while grappling with the necessity of external financial support, offering a nuanced understanding of the complexities involved. Through an illuminating case study focusing on the Danish Centre for Rural Research, the essay provides a rich and insightful analysis of the strategies employed by research centres to navigate these intricate dynamics. A particularly compelling aspect of the authors' approach is their adoption of a systems theoretical framework, which allows for a deeper examination of the paradoxical nature of research centres. By identifying these institutions as operating within the intersecting domains of science, politics, and the economy, the authors shed light on the complex web of influences that shape their activities. Moreover, they raise crucial concerns about the growing reliance of research centres on external funding sources, both public and private, and its potential implications for scientific integrity. The metaphor of the Jester's paradox, employed adeptly throughout the article, serves to underscore the tension between the societal imperatives driving research agendas and the imperative of maintaining scientific rigor and independence. In doing so, the authors provoke critical reflection on the evolving role of research centres in society and the challenges they face in navigating the complex terrain of politics and power dynamics.

Margit Neisig's (2024) article "The role of management science in forming next era semantics" is devoted to the pivotal role of management science in shaping future semantics of leadership and management practice. Expanding her earlier work (Neisig 2017, 2021), advocates for an engaged scholarship approach that aims to narrow the gap between theoretical discourse and practical application by fostering the development of a shared reservoir of semantic understanding. Such engaged scholarship therefore involves deliberate efforts to connect research findings with the public, addressing societal challenges and community needs alike and in a collaborative manner. Conversely, scholars who fail to actively pursue this endeavour are characterized as neglecting their responsibilities in this regard.

The author furthermore suggests that akin to “midwives”, engaged scholars could serve as facilitators who cultivate shared semantics within a polycentric network; yet the article also insists on the necessity of further reflection on the concept of “managing backwards from the future” to facilitate the emergence of a shared semantic reservoir for future leadership and management paradigms. In further detailing her line of reasoning, Neisig draws on the example of research initiatives aimed at finding solutions to grand challenges through megaprojects funded by major foundations or other influential entities. This agenda-setting process typically involves well-established international research hubs and networks, potentially side-lining peripheral regions. Her article therefore contends that establishing regional polycentric networks, inclusive of scientific research scholars, could better reconcile global agendas with local and regional concerns, thereby mitigating the risk of exclusion during the corresponding transitional phases.

The article authored by *Anahit Hakobyan (2024)*, entitled “Communicating scientific knowledge as news on social media: analyses in frames of Luhmann’s system theory,” delves into a topic of profound contemporary significance: the intricate dynamics surrounding the presentation and dissemination of scientific knowledge through social media platforms. In the digital age, social media has emerged as an integral component of the mass media system, characterized by a myriad of complexities including algorithmic biases, echo chambers, filter bubbles, and the widespread dissemination of misinformation and conspiracy theories. This fragmented and polarized digital environment poses a substantial challenge to the effective communication of scientific information, leading to a decline in public confidence and eroding ‘epistemic trust’ in science as a whole. As social media platforms increasingly dominate the landscape of news dissemination, there are profound implications for the transmission of scientific knowledge, particularly evident in the behavioural patterns observed during pandemics and other global crises. Consequently, the prevailing methods of conveying scientific knowledge confront significant obstacles, primarily stemming from the waning trust in social media as a credible communication channel. The author advocates for a comprehensive approach to evaluating trust in science, one that takes into account not only the substance of scientific messages but also the medium through which they are communicated, the credibility of the source, and the intricate interplay between these elements. This contribution sheds light on pressing issues, emphasizing the critical importance of epistemic trust and its effective communication, with far-reaching implications for the continued development and well-being of societies in the 21st century. Furthermore, it provides a robust conceptual framework for analysing the structural coupling between the functional systems of science and mass media, paving the way for further empirical studies to delve into this complex interconnection and its multifaceted ramifications.

In his article, “The systemic challenge and practice of leadership in a post-Centaurian society”, *Lars Clausen (2024)* starts from the observation that the resurgence of war in Europe, as evidenced particularly by the Russo-Ukrainian conflict, has thrust military leaders back into the spotlight, prompting a renewed call for decisive action. Amidst this backdrop, political leaders accustomed to strategies for times of peace are facing criticism for perceived indecisiveness, exemplified by the prolonged debate surrounding the export of Leopard tanks to aid Ukraine. True to Clausen, this shift in focus from peace to war necessitates a re-evaluation of leadership dynamics, with decision-making in wartime demanding a different approach than in times of peace. To visualise this shift of focus, he draws on Luhmannian systems theory to trace through history the intricate relationship between

humans and horses, emphasizing their role in shaping the iconography of power and leadership. Symbolized by the mythological figure Chiron, this centaurian pact is thus deciphered as a fusion of analogue and digital codes, blending animate life with written language, appealing to young men destined for heroism and tragic fate. As societal transformations led to the decline of this pact, however, exchanging its prominence in ancient myths for its contemporary ridicule as a pre-modern anachronism in modern times. The evolution of this pact followed a trajectory marked by the rise and fall of empires, the waning of literacy, and the mechanization of society. As horses relinquished their role to engines powered by fossil fuels, leadership paradigms shifted towards post-heroic ideals, emphasizing relational, other-centred, and collective processes. Despite criticism of post-heroic leadership, contemporary research mirrors age-old principles of horse training, suggesting a rediscovery of heroic leadership traits. The departure of theories like cybernetics and systems theory from horse-related metaphors signals a need to reconnect with the intrinsic heritage of heroic leadership lessons. At the end of his systems-theoretical journey towards understanding leadership in the digital age, Clausen suggests a return to the symbolic significance of equestrian forms, transcending the shadows of the past to navigate the uncertainties of the future.

Conclusions

The six contributions to this special issue of Systemic Practice and Action Research illustrate the dual role of social systems theory as both a theoretical framework and a methodological approach, thus offering a richly productive super-theoretical framework suitable for both theoretical and empirical research in the social sciences.

Contemporary social sciences can indeed use some theoretical superpowers. While epidemiology is “certainly not *not* a social science“ (Roth 2021, p. 6), it has not gone unnoticed that the social sciences have been side-lined during the pandemic (Lohse and Canali 2021). This trend might extend to other grand challenges. If the coronavirus crisis has indeed served merely as a dress rehearsal for the more existential environment crisis (Latour 2021), then the marginalisation of the social sciences is likely to persist and even intensify.

A significant illustration of this trend is the quasi-automatic equation of environment with nature. From a systems-theoretical perspective, it is evident that nature is neither less nor more than the environmental concept of one among several branches of function system science, namely the natural sciences (Roth and Valentinov 2020). However, the fact that other branches of sciences, along with other function systems, possess different concepts of environment remains largely ignored. This oversight is particularly pronounced in environmental policies that increasingly measure all aspects of life, including social life, in terms of impact on “the” environment.

Given the strong and often tacit ties between politics and the natural sciences, social sciences may argue for a re-evaluation of the relationship between organized science and organized politics, akin to the separation between organized politics and organized religion proposed by Feyerabend (1975). This time, however, this divorce would have to be obtained in ways that are neither anti-scientific (*against method*) nor again political (*anarchism*). Rather, what is required is a return of science to its core function.

True, the idea of science for science's sake may not be popular in these times of mode II, third mission, and political activism. But also true is that the more professional roles of organised scientists are overburdened with expectations from other function systems, the lower the role bearers' performance in all these domains. This inflation of academic role expectations can also place *enseignants-chercheurs* into competition with professional fundraisers, journalists, or policy makers, who can still do what academics are not allowed, or do not allow themselves, to do anymore: dedicate themselves fully to their core missions. As a result, the economic and non-economic value of academic work has been in steady decline.

Stopping this trend to increasing self-exhaustion and self-devaluation necessitates embracing the unpopular concept of science for science's sake. However, this can be done with a clear conscience. For if we overcome the persistent self-confusions of society with politics or any other subsystem, then the artificial distinction between science for the sake of science and science for the sake of society collapses, and science for sake of society amounts to nothing more than a return of science to its own function.

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