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Toward a Stronger Theoretical Grounding of Computational Communication Science

How Macro Frameworks Shape Our Research Agendas

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Abstract

Computational communication science (CCS) is embraced by many as a fruitful methodological approach to studying communication in the digital era. However, theoretical advances have not been considered equally important in CCS. Specifically, we observe an emphasis on mid-range and micro theories that misses a larger discussion on how macro-theoretical frameworks can serve CCS scholarship. With this article, we aim to stimulate such a discussion. Although macro frameworks might not point directly to specific questions and hypotheses, they shape our research through influencing which kinds of questions we ask, which kinds of hypotheses we formulate, and which methods we find adequate and useful. We showcase

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how three selected theoretical frameworks might advance CCS scholarship in this way: (1) complexity theory, (2) theories of the public sphere, and (3) mediatization theory. Using online protest as an example, we discuss how the focus (and the blind spots) of our research designs shifts with each framework.

Keywords: Computational Methods, Communication Theory, Complexity Theory, Public Sphere, Mediatization, Computational Communication Science

Computational communication science (CCS) is in its formative stage. Fostered by the computational turn in the social sciences (Alvarez, 2016; Conte et al., 2012; Lazer et al., 2009), many programmatic articles have been published about computational methods in communication research within the last few years (Choi, 2020; Hilbert et al., 2019; Shah, Cappella, & Neuman, 2015; Van Atteveldt & Peng, 2018). While the potential of computational methods for data analysis is obvious, the role of *theory* in this emerging field is unclear and underrepresented. It seems that the rapid development of computational methods has not been accompanied by an equally strong emphasis on theoretical developments within the scholarly community.

Some early voices argued that big data and computational methods would make theories obsolete (Anderson, 2008; Mayer-Schönberger & Cukier, 2013). Given the large amounts of available data, they claimed it would no longer be necessary to draw samples—insights could be extracted directly from the data by inductive pattern exploration. This positivist view has seen a lot of criticism, as even exploratory pattern detection with large data sets necessarily includes numerous theoretical assumptions that are reflected in how data are collected, analyzed, and interpreted (e.g., Mahrt, 2018). Crawford (2013) warns against failing to acknowledge 'hidden biases' inherent in such research designs. Research that lacks sufficient theoretical reflection of the studied phenomena risks producing methodological and/or data-analytical artifacts instead of meaningful findings about social reality (Ruths & Pfeffer, 2014).

CCS scholars demonstrated that computational methods allow the testing of long-standing social theories (González-Bailón, 2017) as well as mid-range communication theories such as agenda-setting (e.g., Vargo, Guo, & Amazeen, 2018). Computational methods were also used to inductively develop and advance theories in a computational grounded theory approach (Choi, 2020; Ophir, Walter, & Marchant, 2020). However, in discussions about

CCS and theory, we observe an emphasis on mid-range and micro theories that misses a larger debate of how macro theories and meta-theoretical frameworks can serve CCS scholarship.

With this article, we aim to stimulate such a discussion. First, we highlight the general use of macro theories for CCS research. Although macro frameworks might not point us directly to specific questions and hypotheses, they frame *how* we think about our research objects. They shape which kinds of questions we ask, which kinds of hypotheses we formulate, and which methods we find adequate and useful. Grounding our research on macro frameworks forces us to be explicit and reflective about such basic epistemological assumptions, and to make theoretically informed choices about research designs.

Second, with the example of online protests and three selected theoretical frameworks, we demonstrate practical implications of connecting CCS research to specific macro frameworks. Complexity theory, theories of the public sphere, and mediatization theory represent diverse disciplinary origins, degrees of abstraction, and quantitative as well as qualitative perspectives. We discuss how the foci and the blind spots of research designs shift if connected to each of these frameworks.

Assessing the Value of Macro Frameworks for CCS

In line with Blumler (2015, p. 436), we understand an approach as a *theory or theoretical framework* if it provides explanations of a wide range of phenomena for which supportive evidence can be supplied. Generally, theories can be divided into macro (or grand) theories, mid-range theories, and micro theories. Micro and mid-range theories focus on specific phenomena and often involve specific theoretical concepts relating to a clearly defined range of contexts. Grand or macro theories build on relatively abstract concepts addressing a superordinate level of interest, often addressing society as a whole (e.g., Allan, 2012). Depending on the macro framework, researchers refer to social systems, social fields, figurations, networks, etc.

Because of their high level of abstraction, macro theories are often criticized for not being easily amenable to empirical research. For example, it is hard to directly derive testable hypotheses from abstract, overarching sociological concepts such as actor-network theory (Waldherr, Geise, & Katzenbach, 2019). Nevertheless, we see considerable value in the use of macro theories for CCS research, as they force us to be clear about the epistemological assumptions of scientific work (Resnyansky, 2019). They

demand answers to crucial questions such as: How do we make sense of the world? What is our research interest (explanation, description, norm-setting, or criticism)? Which actors and/or structures are important in explaining the social processes we want to study?

In a current assessment of the field, we observe a number of implicit assumptions in CCS research, e.g., that it is possible to draw conclusions about social realities from digital trace data or to find technical solutions for social problems (Geise & Waldherr, in press). Reflecting on these premises sheds light on the way we theorize the relationships between different representations of reality and the role of technology vs. society. If we organize our thoughts in terms of macro frameworks, we make explicit the lenses through which we observe the world. This has profound consequences for the way we design research questions, hypotheses, and measurements. We are convinced that more awareness of these interdependencies between theory and methods allows CCS researchers to make more theory-informed, and thus better, decisions on research designs and interpretations of results.

Evaluation Criteria

When characterizing the emerging field of CCS, we can distinguish three main drivers: First, although CCS entails much more than collecting and analyzing digital trace data, the rapid surge of CCS has been catalyzed by the digitalization of everyday lives and the massive availability of data (Hilbert et al., 2019; Shah et al., 2015). A second driving force of CCS are digital methods for analyzing and modeling these data and the complex processes in which they are generated. These methods are data- and computation-intensive and often show a high degree of automation, such as the analysis of digital trace data, theoretical computer simulations, and large-scale virtual experiments (Hilbert et al., 2019). Third, we see that digitalization, datafication, and the resulting consequences on individual and societal levels are also substantive foci of CCS research. The same technologies that enable us to collect digital trace data and to develop digital methods are generating social problems, which CCS scholars study using these very data and methods.

Many CCS scholars analyze big social problems where communication technology might be a cause or a solution—or both. Typical examples of such phenomena are, to name just a few, filter bubbles, digital divides, polarization, populism, or the spread of misinformation. These issues can be characterized as *wicked problems*, a term originally coined in public policy (Rittel & Webber, 1973). According to Weber and Khademian (2008, pp. 336–337) wicked problems possess three central properties: (1) they are *unstructured*, meaning that they entail a high degree of uncertainty

and potential for conflict about problem definitions, making causes and effects extremely difficult to identify and heightening the likelihood of unanticipated consequences; (2) they are *cross-cutting*, in that they entail many overlapping subsets of highly interdependent problems that involve a wide range of actors and organizations across different domains and levels of hierarchy and aggregation; and (3) they are *relentless* in the sense that they pose ongoing challenges that cannot be solved once and for all with one appropriate action. Instead, efforts to solve these problems will have consequences for other issues and domains. At this point, following Conte et al. (2012), macro theories come into play: 'Undoubtedly, we are developing valuable instruments and techniques for generating, gathering, and analyzing data about grand challenges, but how about [...] grand theories matching grand challenges?' (p. 331). To tackle large-scale problems, CCS scholars need theoretical thinking on an overarching, macro level of analysis.

Although CCS researchers also regularly investigate traditional communication and media phenomena such as social influence and political mobilization (e.g., Bond et al., 2012) or trends and patterns in news content (e.g., Jacobi et al., 2016), a growing number of CCS researchers concentrate on the analysis of phenomena that can be classified as wicked problems (Geise & Waldherr, in press). There can be various reasons for this trend: CCS researchers may find dealing with these complex problems particularly challenging and tempting, or they may observe particularly strong research gaps, or a particularly high social relevance. At the same time, CCS researchers obviously regard computational methods as particularly promising and enlightening.

From the characteristics of the wicked problems that CCS scholars typically deal with, we infer three criteria to guide our following discussion of macro theories:

- *Normativity:* Normative frameworks guide defining an unstructured problem and assess possible solutions. We discuss to what degree a theoretical approach allows critically reflecting and uncovering inherent and implicit normative premises, and to what extent a theory lends itself to the necessary reflection of possible hidden biases of research designs and data sources.
- *Interdependencies:* The unstructured, cross-cutting nature of many CCS problems leads to myriad interdependencies between various (sub-) issues and actors on different levels of organization. We discuss the extent to which a macro framework helps CCS scholars conceptualize and analyze interdependencies between human actors, groups, organizations, and technical infrastructures.

– *Multi-level dynamics:* As wicked CCS problems cut across different levels of aggregation and show unstoppable dynamics with many feedbacks and unintended consequences, CCS scholars need macro frameworks to deal with these complex multi-level dynamics. We discuss to what degree a macro framework supports theorizing dynamic processes on multiple levels.

Choice of Theories

We have chosen frameworks from different disciplines that have various degrees of abstraction and promote both quantitative and qualitative perspectives to provide diverse avenues for future CCS studies. The selected theories are more or less common in communication research, which reflects our assumption that CCS can benefit from both well-established and less frequently used theories.

Complexity theory started in the STEM, that is, science, technology, engineering, and mathematics, disciplines, but has increasingly influenced research in economics and the social sciences and shows high applicability to communication problems. *Theories of the public sphere* originated in political philosophy and sociology, but have become a well-established framework in communication research. *Mediatization* addresses questions of digitalization and datafication that are fundamental for communication researchers.

Our choice of three theories is a conscious selection, and the following elaborations are therefore exemplary. Our aim is to highlight what CCS scholars can gain by connecting their work to established macro-theoretical social frameworks.

The Example of Online Protest

We use *online protests* to illustrate how macro theories frame research questions, hypotheses, and methods when studying wicked problems. *Protests* can be defined as a mode of collective 'political action oriented toward objection to one or more policies or conditions, characterized by showmanship or display of an unconventional nature, and undertaken to obtain rewards from political or economic systems while working within the systems' (Lipsky, 1968, p. 1145). They are fundamental to modern democracies and have become increasingly important in online environments (Theocharis, 2013). Online protest may distribute information via digital media, replace traditional forms of protest with their electronic counterparts (such as e-petitions or e-mail instead of letters to media or political actors), or employ digital infrastructures to organize protesters and coordinate their actions (Earl, 2010).

Contemporary protest research analyzes how digital media and social networks influence online protests, and shows that information shared via online social networks can strengthen protest movements, increase citizens' mobilization, and trigger contagion effects (e.g., Bennett & Segerberg, 2013; Casas & Williams, 2018). Since these mechanisms and interconnections have digital traces, online protests have become a popular research field among CCS scholars.

Studies analyze, for example, the dynamics of protest diffusion (González-Bailón, 2017), the use of pictures in the Black Lives Matter movement (Casas & Williams, 2018), or networks among protesters at British universities in 2010 (Theocharis, 2013). These studies differ in their computational methods and theoretical grounding. Given this diversity of perspectives, and the complex, multi-level, and dynamic nature of protests, they are an ideal domain to showcase how macro-oriented theoretical frameworks can deepen the analysis and understanding of wicked societal phenomena in CCS.

Complexity Theory

Since the early 1990s, complexity research has developed from its roots in physics, mathematics, and information science to an interdisciplinary approach for studying the behavior of complex systems (Miller & Page, 2007). There is no *single* complexity theory. Instead, it is a label for a diverse set of concepts that are variations and further developments of systems theory and cybernetics. However, complexity theories share important common ideas that have been considered a new paradigm for the study of systems of any kind (Sherry, 2015).

Complexity scholars typically focus on open systems and aim to explain change (Sawyer, 2005). Recurring concepts and characteristics of complex systems are the interconnectedness and heterogeneity of their components, which self-organize without central top-down planning. Through their adaptive behavior, they generate emergent higher-order patterns and nonlinear phenomena such as tipping points (sudden catastrophic changes in a system's state after a long phase of stability) or butterfly effects (minor impulses reinforced through positive feedback leading to drastic changes in a system) (Miller & Page, 2007).

Many applications of complexity theory touch upon core interests of communication science, particularly models of opinion dynamics and social influence (Flache et al., 2017). However, to date, few communication scholars explicitly refer to ideas of complexity research. This is astonishing, because,

as Sherry (2015) points out, communication is an inherently complex and dynamic process, and should be studied as such. As we highlight in the following, many phenomena that are particularly popular in CCS research show basic characteristics of complex systems. Complexity theory serves two of our evaluation criteria extraordinarily well: (1) multi-level dynamics, and (2) interdependencies, which are at the heart of every complex system.

Multi-level dynamics: Complexity researchers are particularly interested in unstable, nonlinear, often chaotic, and unpredictable multi-level dynamic phenomena. This perspective resonates well with many wicked phenomena of digitized communication—such as firestorms, viral memes, and flash mobs. The complexity approach offers a bottom-up perspective and an explanatory approach to these phenomena, regarding them as emerging from micro interactions between components—or actors in social systems.

Online protests are an emergent macro phenomenon generated by multiple interactions between early protesters and their followers. Research questions from a complexity perspective are: What are the micro mechanisms generating a large online protest? Why do some protests rapidly expand, while others quickly disappear? Are there tipping points where the development might take different paths? Important mechanisms at play are individual calculations of costs and benefits among the protesters (Epstein, 2002) and processes of social contagion (Centola, 2013). The latter may influence perceived grievances and social costs of protesting and can trigger cascades of protest behavior on social media and in the streets (Asgharpourmasouleh, Fattahzadeh, Mayerhoffer, & Lorenz, 2020; Hu, Cui, Lin, & Qian, 2014).

Thinking in terms of complexity has profound consequences for the way scholars formulate hypotheses. Simple schemes of dependent and independent variables are not adequate, because complex systems are driven by adaptive behavior and resulting feedback loops, often leading to nonlinear outcomes. Positive feedback, for example, fosters contagion dynamics, especially if people have different propensities (or thresholds) to protest (Granovetter, 1978). Positive feedback often also leads to nonlinear dynamics such as exponential growth (Miller & Page, 2007): The more people join a protest, the more others with higher thresholds are inclined to follow. Instead of formulating hypotheses of how independent variables influence dependent variables in a linear way, complexity researchers develop hypotheses on what rules and mechanisms generate which types of system-level behavior. Centola (2013) thus proposes a complex contagion mechanism with multiple social reinforcements to model how protest behavior spreads. As complex systems often have built-in (nearly) chaotic

behavior, researchers also might hypothesize that the exact path an online protest takes will be unpredictable, but they can nevertheless produce an ensemble of possible futures or typical patterns of how online protests evolve.

Concerning methods, classic linear regressions are of only limited use in systems thinking. To model complex systems, communication researchers must embrace techniques of computer modeling such as agent-based models (ABMs) and simulation (Sherry, 2015; Waldherr & Wettstein, 2019). These methods allow the exploration of emergent processes across multiple levels of aggregation that are hard to tackle with more conventional statistical approaches (Miller & Page, 2007).

In ABMs, individuals are implemented as software objects (agents) with specific attributes and goals that can process information according to defined interaction rules. For example, simple ABMs of social protest include agents with different thresholds to protest (e.g., Hu et al., 2014), while more complex models of violent protests may include police as a special type of actor (Epstein, 2002). Agents can perceive information from the environment (e.g., the number of protesting agents in their neighborhood). Based on this information, they decide if they want to protest themselves. Such simulation models can be combined with real digital trace data to find theoretical explanations for empirical patterns and to develop valid model assumptions. For instance, Asgharpourmasouleh et al. (2020) used data from two empirical cases to calibrate their model on the Iranian protests in 2017–2018 and the German PEGIDA movement from 2014 onward.

Interdependencies: In digitized communication systems, actors are connected with others in friendship, following, addressing, hyperlinking, etc. These interdependencies between social actors and their environment are the essential infrastructure of complex systems (Barabási, 2016). Likewise, social networks serve as communication channels that define information flows and social influence (González-Bailón, 2017).

Taking actors' interconnectedness seriously leads to two types of research questions. On the one hand, it stimulates an analysis of how protest networks emerge, including the evolution of the network itself as a modeling target. Network scientists proposed several generic network algorithms such as small-world networks (Watts & Strogatz, 1998) or preferential attachment (Barabási & Albert, 1999), and social scientists developed ABMs that simulate the emergence of social networks with specific characteristics (Hamill & Gilbert, 2009). On the other hand, scholars can examine how different network topologies influence other target processes such as protest diffusion or mobilization (Centola, 2013; Piedrahita et al., 2018). For example, Hu et al. (2014) show in an ABM how digital communication can have either

accelerating or dampening effects on protest mobilization depending on the underlying network structures in collectivist versus individualistic cultures.

Studying protests from a complexity perspective means that CCS researchers need to formulate hypotheses on network effects. Next to computer modeling and simulation, network analyses are significant in complexity-oriented research and are already well established among communication scholars (Foucault Welles & González-Bailón, 2020). Network analyses are used extensively to analyze online social protests (e.g., Bennett, Segerberg, & Yang, 2018; Theocharis, 2013). However, many of these analyses remain rather descriptive. Specifically, data points in networks are typically neither independent from each other, nor normally distributed, but tend to produce heavy-tailed distributions (Broido & Clauset, 2019). To adequately test hypotheses on network data, advanced inferential methods such as Exponential Random Graph Modeling (ERGM; e.g., Lusher, Koskinen & Robins, 2013) are needed.

While norms and biases may be studied and modeled as emergent social phenomena in a complex system, *normativity* in the sense of our third evaluation criterion is not directly addressed by the complexity framework, and certainly is a blind spot of this approach. In fact, complexity research has been repeatedly criticized for promoting a positivist and reductionist perspective of methodological individualism toward society (e.g., Sawyer, 2005).

Theories of the Public Sphere

Theories of the public sphere have strong ties to other disciplines—in particular, political science and philosophy—but are much more established in communication science than complexity theory. They are widely influenced by democratic theory, standards of deliberation, and their normative implications. Whereas democratic theory focuses on the decision-making process itself, theories of the public sphere seek to describe how public communication can best facilitate accountable and responsive decision-making. Therefore, theories of the public sphere are an important framework for the study of protests.

Generally, the public sphere is considered a counterpart to the private sphere (Papacharissi, 2009) and is usually conceptualized as open and socially accessible. As a domain of social life, it is a sphere in which matters of general interest are negotiated, such as protest issues that (can) affect society. More demanding normative perspectives suggest that social decision-making

should be rooted in the public sphere itself, understanding it as an intermediary system between the institutions of the state and society (Habermas, 2006). Critical theorists are particularly concerned with the boundaries of the public sphere that could endanger the status of public communication (Dahlberg, 2018): When do societal and technological constraints of the public sphere systematically lead to exclusions or limitations concerning the visibility of (protest) issues, perspectives, and actors? What might endanger their visibility—including media visibility and network visibility—and who should control it?

Theories of the public sphere are well-integrated into communication theory to evaluate the democratic potential of digital media (Dahlberg, 2018; Papacharissi, 2009). They provide a heuristic set of criteria to assess public discourses in modern democracies and formulate normative expectations for functioning public spheres. In the context of democratic theories, scholars often differentiate between representative-liberal, discursive, participatory, and constructionist approaches (Ferree, Gamson, Gerhards, & Rucht, 2002). Throughout these approaches, special attention is paid to the functions, structures, and preconditions of the public sphere.

Proponents of the liberal model want to ensure that communication in the public sphere adequately represents societal interests and majorities. In comparison, theorists in the discursive tradition consider it more important that the public sphere facilitate public decision-making oriented toward well-justified, rational, and argumentatively convincing positions (Habermas, 2006). In contrast, participatory democracy theorists emphasize the idea that all those affected by a given issue should have a voice as active citizens. This position aims at maximizing popular inclusion and participation. In the agonistic or constructionist tradition, citizen empowerment matters most. This strand of theory aims at privileging oppressed groups and allows authentic non-deliberative forms of communication, whether they be factual, emotional, or disruptive (Schäfer, 2015). While theories of the public sphere originally focused on traditional mass media, their perspectives also matter for the digital realm.

Normativity: Each of the public sphere frameworks emphasizes different democratic norms. Theories of the public sphere provide a normative frame to identify problems in the composition of (digital) public spheres. The different theoretical lenses do not point to specific hypotheses, but they inspire different analytical pathways and normative expectations. For our example of online protests, mechanisms of inclusion and exclusion are relevant, which are conceptualized differently within each framework. Within the representative-liberal framework, scholars investigate whether

all relevant societal groups are represented adequately in a digital public sphere (Ferree et al., 2002). This puts actor composition and the diversity of viewpoints under scrutiny. Researchers would address phenomena such as overrepresentation, manipulation, and other potential distortions.

Scholars in the tradition of the discursive model, on the other hand, might assess participatory equality and the autonomy of those participating in public discourse. They may define norms for a good and reasonable exchange of arguments such as rationality and civility (Freelon, 2010). However, many forms of online protest deliberately violate such discursive norms. Adopting a discursive approach in a CCS protest study would imply hypotheses that help assess the level of rationality in digital discussions. Researchers in this context might analyze, in particular, whether and how viewpoints are exchanged using justifications. Furthermore, the dialogue, tone, and (in)civility of protest debates might also come under linguistic scrutiny.

Scholars following the pathways of the participatory framework in its constructionist tradition also question who participates. They study online protest as a form of increasing participation and popular inclusion and a way to empower minorities and marginal voices, which may not be civil but is authentic in creating counterpublic spheres vis-à-vis the mainstream (e.g., Jackson & Foucault Welles, 2015). Given that popular inclusion is a leitmotiv in this tradition, research around online protest would critically examine their scope, variety (e.g., in terms of creativity), authenticity, and emergence in digital public spheres.

Following from their respective normative approach to public spheres, scholars not only investigate interactions forming around online protests, but also the (societal) background of the actors involved. Explicating these normative criteria opens up standards for reflecting our research designs as well as potential distortions. These criteria help to identify exclusions on different levels (e.g., marginalized perspectives based on the framing of events and news, underrepresented actors, neglected topics). By locating exclusions and missing perspectives, this approach contributes to detecting and questioning specific platform biases. In this regard, also the platform structures shaping networked interactions and their potential for misuse require further reflection. A theory of the public sphere most suitable to CCS research should emphasize the potential equality to be seen and heard, as well as the technological resources enabling control over visibility (Dahlberg, 2018). Non-human actors who are part of these structures should be identified to assess the performance of networked publics with the given criteria.

Interdependencies: In a recurring debate, communication scholars question the capacity of the public sphere to consolidate and integrate public

opinion. In the process of digitalization, the public sphere has transformed into many smaller, though loosely coupled, public spheres—often evolving around specific issues. Bruns and Highfield (2016) recognize a dynamic and complex system of issue-driven publics and unpack the digital public sphere into a series of fine-grained micro-publics that coexist, intersect, and overlap in multiple forms without being mutually exclusive. The structures and conditions of digital connectivity—and the dynamics of information flow in, and especially between, networked publics (Boyd, 2010)—need to be assessed. The increasing availability of digital trace data opens up several avenues for research in this direction (Choi, 2020).

To conceptualize these developments, network theories and public sphere theories have been increasingly connected to the notion of *networked public spheres* (e.g., Benkler, 2006). Methodologically, studies in this area combine network analyses with various methodological approaches such as content analysis or topic modeling (Kaiser & Puschmann, 2017; Nuernbergk, 2014). They thus evaluate networked public spheres through considering the visibility and plurality of different types of actors and topic-related positions. Since bot activities may be present in the networked public sphere, studies that follow public-sphere conceptions have to critically question non-authentic and automated behavior in discourses, as well as other distortions in terms of representation and visibility. Keller and Klinger (2019) break down why bots are potentially problematic from each of the normative perspectives presented here. They also present challenges for the validity of social media and engagement analytics because they distort the measurement of actor and viewpoint popularity and of relevant interactions. Especially studies on bot detection and bot reach need to dedicate more time to the validation of automatically classified accounts (e.g., Keller & Klinger, 2019). This also emphasizes that we should carefully consider the specific limitations of input variables in predictions and models to avoid hidden biases in our research designs (Bolsover & Howard, 2017). In light of theories of the public sphere, not all big data signals are thus directly suitable for a better understanding of public discourse.

Regarding our example, it would be interesting to study the networked interplay between protest actors and opposing groups to analyze the formation and development of counterpublics. This raises the question of how contemporary protests are becoming visible through networked information flows. From a public-sphere perspective, the study of information flows must consider corresponding actor information. Bennett et al. (2018), for instance, analyzed the interplay between periphery actors and central Occupy Wall Street movement actors in terms of networked framing and the shaping of

public attention. Based on tracking data, they classified accounts by their social origin and analyzed the networked attention to issues over time by different types of actors (e.g., alternative media, public figures).

Multi-level dynamics: Concerning networked public spheres, network analysis addresses the relational embedding of actors and the many interactive paths that can influence the spread of information in a complex media ecology. A dynamic network approach could identify stable and ephemeral connections and may reveal shifts between thematic clusters, the center, and the periphery of a public sphere over time. However, this requires a systematic comparison of different issues and their visibility dynamics through linking practices and other types of interactions over time; this is still an exception in studies of the public sphere (e.g., Kapidzic, Neuberger, Stieglitz, & Mirbabaie, 2018).

The combination of longitudinal network analysis, topic modeling, and (automated) content analysis seems to be a fruitful avenue to extract relevant relations from digital trace data to observe dynamic changes in mediated conflicts. What comes into question then are size, reciprocity, and stability (in terms of protest participants, actors, networked interactions, and frames) of digital publics on multiple levels. This information is crucial to systematically assess the social conditions of networked publics and their particular inequalities. Concerning levels of connectedness, Barberá et al. (2015) examined the hierarchical structure of protest networks, showing how the (aggregated) influence of many individual users on the periphery can change the reach and activity of online protests. However, although the respective studies in the protest context offer fresh and substantial avenues for research examining networked public spheres, we must acknowledge that they only roughly investigate the actors' background. If the authenticity, diversity, and plurality of actor contributions are to be assessed more thoroughly—in line with the outlined criteria of the present paper—CCS researchers will need qualified and validated information on actors. That includes the need to organize data on actors more systematically and sustainably in future studies.

(Deep) Mediatization and Communicative Figurations

Mediatization theory addresses the idea that technological changes are interrelated with long-term changes and culture-crossing developments (Krotz, 2007), suggesting a historical transformation in the importance of media for society. The scope of mediatization has increased considerably

over the years. Initially conceptualized as specific processes of adapting to media logic (e.g., Mazzoleni & Schulz, 1999), it is now proposed as an ongoing, dynamic process of media-related transformations on temporal, spatial, and social levels (Krotz, 2007). Capturing the multifaceted and interrelated consequences of media change on multiple levels of analysis, mediatization research ranges from the everyday life of individuals to organizations, groups, and societies, making it a key example of how to understand and study wicked problems.

While the framework of mediatization has already proven its ability to bridge various disciplines and methodological angles in fruitful ways (Couldry & Hepp, 2013; Krotz, 2007), researchers have also presented a variety of empirical studies examining the mediatization of protest in online and social media (e.g., Brantner & Rodriguez-Amat, 2016; Daubs, 2017; Mattoni & Treré, 2014). As these studies illustrate, mediatization theory seems particularly suited for studying the nexus between social movements and digital media because it can provide differentiated explorations of the multiplicity, interconnections, and multi-level dynamics of old and new media for social change, as well as feedback on protest communication and action. The integration of theoretical premises from mediatization research into CCS promises enormous potential for concrete approaches to the further theoretical and empirical development of protest research, some aspects of which we outline below.

Interdependencies: Mediatization theory suggests that researchers should empirically investigate 'how the "formative forces" of different media become concrete along [...] different dimensions and in different cultural fields' (Hepp, 2009, p. 144). The framework explicitly leads to research questions addressing interdependencies between long-term transformations of technologies, media, and communication on the one hand and sociocultural changes on the other, seeing both as integral parts of everyday communication practices and the social construction of reality. Addressing such interdependencies of humans, technical actors, and/or infrastructures informed by mediatization theory, Brantner and Rodriguez-Amat (2016), for example, demonstrated how mediatization multiplies communication and spaces in social media-supported protests.

As those interdependencies differ qualitatively according to the social domain under consideration (Hjarvard, 2013), empirical analysis must examine transforming communication in its meaningful social contexts (such as a particular protest movement). To explicate this contextualization, Hepp and Hasebrink (2018) proposed the concept of *communicative figurations*. As communicative constructions of a network of individuals (such as a protest

group), communicative figurations are located at the meso level of social groups and consist of specific constellations of actors. These actors align their actions with dominating frames of relevance, which define the overarching 'topic' of the respective figuration. Communicative figurations emerge from communicative practices and always form a particular entanglement with a certain media ensemble. The concept provides mediatization with clear-cut objects of inquiry and invites specific questions such as: How are the social realities of a particular protest figuration constructed communicatively? What are the prevalent communicative practices of a figuration, and which media enable these?

Understanding hacking as one particular type of political protest, Kubitschko (2018) applied the concept of communicative figurations in outlining how hackers' political engagement relies on practices related to innovative media technologies and infrastructures. He also shows that their actions are still oriented toward larger publics and traditional centers of political power. While he performed qualitative research on the Chaos Computer Club and its positioning in the normative public discourse around media technologies, an additional application of computational methods would allow further examinations, such as following the actors' digital traces and virtual networks. A mediatization approach provides a deeper look into the normative communicative construction of media technologies and infrastructures as, for example, a threat to individual and social freedom. Since applying the concept of communicative figurations means to shift the focus of analysis to specific actor constellations, communicative practices, and their frames of relevance, computational approaches help protest researchers to measure and further examine these aspects of mediatization empirically.

Informed by the assumptions of mediatization theory, CCS researchers could apply, for example, web-tracking tools and automated content analysis to better understand those mediatization mechanisms. Because the concept of communicative figurations suggests that their meaning is ultimately tied to their social contextualization, scholars aiming to determine the communicative figuration of contemporary protests should apply computational approaches that allow a detailed analysis in a cross-media perspective. Data of cross-media practices on group communication, interaction, and protest activity thus could improve the understanding of protest as a social phenomenon by means of figurative analysis, asking, for example: How does protest communication develop? To what extent do actor constellations transform with a changing media ensemble in a given communicative figuration? How does this change over time, and due to what changing

technological and hierarchical structures of communication? What are the consequences of such developments for a figuration's frame of relevance? Such an approach, however, challenges the researcher to contextualize (automatically) collected digital trace data to assess their meaning as a whole.

Normativity: Through explicitly addressing the social context, communicative figurations inherently direct the researcher's attention to hidden biases embedded in the data or research design, asking, for example: What social inequalities, power relations, or conflicts characterize the communicative figuration under examination? What consequences follow from these relations? Such considerations can stimulate further analytical reflection and empirical investigations from a more meta point of view, as hidden biases are potentially incorporated in automatically generated and processed data that researchers examine, particularly in CCS. As Couldry and Hepp (2016) examined, the surface of mediatized communication may not necessarily mirror mediatized social reality but could merely display the product of underlying continuous and largely automated data analytics. If scholars take this critical mediatization perspective further, they can justify both methodologically and theoretically that not every available big dataset can—or should—be used for empirical research (e.g., Hargittai, 2015; van Atteveldt & Peng, 2018). Nevertheless, the integration of the mediatization concept does not intend to demonize big digital data: Rather, the concept of mediatization in general and communicative figurations in particular sensitize researchers to the fact that increasing algorithmization can produce self-referential, self-implementing media structures, content, and interactions. This invites critical reflection on the phenomenon of mediatization not only from an empirical, but also from a methodological perspective—an inspiring avenue for CCS.

Acknowledging such ongoing processes of digitalization and datafication, Couldry and Hepp (2016) have recently suggested the notion of *deep mediatization* to designate 'a much more intense embedding of media in social processes than ever before,' in which the very elements and building blocks and communicative figurations that construct social reality 'become themselves based in technologically based processes of mediation' (p. 7). This idea is at the very heart of CCS as well, as the data traces and fragments users leave when appropriating digital media are a core mechanism of deep mediatization—exactly what communication scholars regularly investigate when applying computational methods. The idea of deep mediatization can draw researchers' attention to the quality and quantity of the fundamental changes in social lives due to the rise of computational phenomena such as machine learning algorithms or big data. Based on the idea of deep

mediatization, Andersen (2018) explored how technical infrastructures such as search engines, algorithms, and databases—which are embedded in a variety of social and cultural practices—shape communicative actions by their logic of archiving, ordering, and searching. These reflections on the molding forces of digital media (Hepp, 2009)—such as the power and 'ideology' of digital media—indicate how mediatization theory can inform a *normative* perspective rarely addressed in CCS research and the study of online protests, potentially leading to suggestions on how computational research can help societies correct resulting biases. It may also inspire scholars to understand the mediatization of online protest as a transformation process that is not limited to mutual relations between media, politics, and protest movements, but also includes the economic organization of transnational social media companies and their different approaches to regulate deviant opinions and protest actions in the digital sphere.

Multi-level dynamics: The broader theoretical framework of mediatization and the related concepts of deep mediatization and communicative figurations all imply an increased importance, and sometimes even dominance, of digital media in late modern societies. As we aimed to illustrate, many research questions and hypotheses suggested by mediatization theory are ideally suited for further investigation using computational methods, particularly those intended to bridge different levels and dynamics of mediatization processes. Here, the combination of qualitative approaches with CCS methods allows merging the mapping of large-scale social developments and communicative dynamics with a substantive understanding and evaluation of the multi-level dynamic processes under study. In this vein, Hepp, Breiter, and Friemel (2018) argue that such an approach specifically allows putting computational analyses into context—the context of the cultural, political, and scientific discourse in which they are positioned, the specific methods they apply, and the context of the field under study.

Mediatization assumes a historical increase in the relevance of media for a wide range of social and cultural spheres (Krotz, 2007), suggesting that data need to be examined over large periods in longitudinal research designs. The increasing availability of digital trace data makes computational models and analyses directly applicable here. A central question that can be discussed is the degree to which visible online traces of mediatized protest actions are related to general developments of protest movements and their impact (e.g., Hussain & Howard, 2013).

Conclusion

This article has discussed how three macro-level theoretical frameworks and their specific perspectives can inform CCS research, particularly in the study of wicked problems such as online protests. As summarized in Table 1, each theoretical concept provides specific contributions to the field. We do not seek to single out these specific theories, nor their evaluation criteria; rather, together with the chosen domain of protest research, they serve as examples to substantiate and illustrate the overarching argument: CCS scholars will benefit significantly from connecting their empirical, often highly innovative work to established macro-theoretical frameworks. These frameworks make explicit how our research foci and research designs are shaped by (implicit or explicit) theoretical underpinnings, and how the latter significantly impact our research questions, hypotheses, and methods.

We have shown that different approaches highlight different aspects (questions, hypotheses) of a research object, such as online protests, and call for different methods to accommodate them. Our theoretical frames function as lenses with different focal lengths, directing the researcher's view to different dimensions of analysis. Complexity theory, for example, accounts for dynamic, nonlinear, and networked phenomena, which we witness increasingly in digitized communication and information environments. Compared to this rather general framework, mediatization is explicitly developed to zoom in on the dynamic meta processes of media change and digitalization in everyday communication. Theories of the public sphere, in contrast, take a wider angle on public communication on the societal level and the normative expectations tied to it in democracies. Applying them in CCS research helps to reflect on mechanisms of exclusion in digitized public spheres.

As illustrated by examples from extant research, the choice of theoretical frameworks shapes the research process in many ways. Macro-theoretical frameworks help researchers be more aware of these connections to make theoretically informed decisions on research designs and on methods of data gathering and analysis. For example, to study online protest, a CCS scholar must decide: Do we normatively understand protest as a legitimate form of participation? Do we study short-term dynamics of how online protests emerge, or do we study long-term processes of how protests are increasingly mediatized? Do we focus only on one type of data from one platform? Or do we contextualize this data within the platform's architecture or the users' media repertoires? These are only a few of the questions we have elaborated on above, and we have shown that such questions can be answered by grounding CCS research in macro-theoretical frameworks such as the ones discussed in this article.

Table 1 Implications of Each Theory for CCS Research

	Complexity Theory	Public Sphere	Mediatization
Questions	– Emergence of social macro patterns out of individual interactions **(multi-level dynamics)** – Impact of network topologies on dynamic processes **(interdependencies)**	– Conditions for visibility and inclusion of actors, issues, and perspectives **(normativity)** – Fragmentation and integration **(interdependencies, multi-level-dynamics)**	– Long-term changes in media and their sociocultural contexts – Communicative figurations that construct social realities **(interdependencies)** – Social inequalities, power relations, or conflicts **(normativity)**
Hypotheses	– Feedback loops and nonlinear outcomes – Mechanisms generating macro patterns **(multi-level dynamics)**	– Normative expectations for a functioning public sphere as heuristic criteria **(normativity)** – Salience of topics and actors as embedded elements **(interdependencies, multi-level-dynamics)**	– Accounting for contexts of media routines and cross-media-repertoires **(interdependencies, multi-level-dynamics)** – Accounting for molding forces of media **(normativity)**
Methods	– Integration of computer modeling and simulation with digital trace data **(multi-level dynamics)** – Network analysis **(interdependencies)**	– Network analysis taking into account relational embedding of actors – Combination with (automated) content analysis and actor classification **(multi-level-dynamics, interdependencies)**	– Integration of qualitative approaches with digital trace data and tracking tools **(interdependencies)** – Critical reflection of research data and processes **(normativity)**

Our contribution is necessarily limited: First, we were only able to discuss three exemplary theories—obviously, many more are conceivable as fruitful theoretical frameworks for CCS research. Second, we have evaluated each theoretical framework based on three criteria: normativity, interdependencies, and multi-level dynamics. We consider these as highly relevant to current phenomena and debates. Yet this might be controversial—and such an evaluative grid can change. Not only is the increasing digitalization and algorithmization of communication processes shifting tremendously, but also the field of computational research and its methods are subject to constant development. Researchers might use other criteria to identify appropriate theoretical frameworks for their research interest.

Nevertheless, our account shows that CCS profits substantially from varying and advancing not only methodological, but also theoretical, perspectives. We have taken protest research as an example, but the essay more broadly illustrates how different theoretical perspectives can guide computational research, ranging from more general aspects to research questions, from hypotheses to methodological designs and requirements for data analysis. Ideally, this will foster further advancements such as the development of specific tools of computational data collection and data analysis. In this way, theoretical and methodological developments in CCS research will mutually advance each other. If our meta-reflection can contribute to such a pronounced foregrounding of the role of theory in CCS research and to the advancement of theoretically informed methods, it has achieved its goal.

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