

Transposing Information Theory From Engineering to Public Administration: Meta-Analysis on Noise in the Communication of the Brazilian Government

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Abstract: Transparency in public communication is, in theory, an integral part of state management with a participatory profile. Fundamental to the consolidation of the democratic regime, it is one of the desirable attributes for greater effectiveness of social control and accountability. One of the main properties of transparent communication is the integrity of information in relation to the data source. According to the general Information Theory system of Shannon and Weaver, the distortions in the original message (which, when altered, cease to be integral) are caused by noise. This article applies this general system, originally built in the area of communication and electronic engineering, to organizational communication and its semantic aspect, based on previous works that used similar adaptations. The goal is to provide methodological support to analyze what has been published by other Brazilian authors that deal with public administration in relation to barriers to transparency and, therefore, noise, framing the results with a meta-analysis strategy. The research gathered 70 articles available in the Spell electronic library database, since the Access to Information Law came into effect in 2012 in Brazil, for the performance of Content Analysis. The frequency of concepts led to the classification of four thematic categories of noise: insufficient availability, difficult accessibility, selective disclosure and impaired decoding. The categorization and proposed analysis can be used in future works on public management or organizational communication, based on the transposed model of engineering.

Key words: information theory, noise, transparency, organizational communication

1. Introduction

Social control presupposes the monitoring of public administration by citizens so that the management of the State is subjected to accountability, evaluation, rewards and/or punishment. This logic is a crucial part of the democratic system and, in the case of Brazil, advances to the extent that discussions of state activity can occur with the free circulation of data, news, and content distribution in general. Thus, “social control” appears as a concept linked to another term: “information”.

The publicized information on public management is provided for in the 1988 Brazilian Constitution and

allows civil society to have knowledge, among other factors, of the allocation of government financial resources and the efficiency of public policies [1]. This knowledge is essential for the accountability of state entities. Failure to meet the public interest, of measures taken or of policies implemented, may result in the removal of a political representative’s position through an electoral or impeachment process [2]. For the best exercise of accountability, it is desirable that the information be transparent.

In this case, transparency presupposes a continuous flow of government information made available to citizens [3]. More broadly, transparency also requires the fulfillment of a series of criteria: free, available, understandable information, directly accessible by those who will be affected by the decisions resulting

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from it, provided in a complete way in appropriate means of communication [4]. In addition, Bernardo et al. (2017) [5] argue that this information must be able to communicate the real meaning it expresses, so that it does not seem misleading. The message must be complete.

The integrity of the message is also addressed in the Information Theory, formulated by mathematician and engineer Claude Shannon and mathematician Warren Weaver (1949) [6], when analyzing the possible alteration of the initial information transmitted by a sender and decoded, ultimately, by a receiver. Although the concern of the authors was technical and not semantic [7], the general system formed by emission/encoding/channel/decoding/receiver is widely used in the social sciences, as a scheme for the analysis of communicational flow [8]. Adapted in different studies, the theory originated in engineering and mathematics, published in the 1940s, and it understands “noise” as an element responsible for interfering with the emitted message, modifying the original information at some point in the communication flow.

Considering that noise in communication is a factor that is contrary to the transparency of information, we use a meta-analysis process [9] to ask: what are the noises identified in Brazilian academic production on public management that can negatively influence the transparency of information?

The objective of this work is to analyze, in Brazilian publications on social control and transparency, how noise is characterized and how it interferes with the original information, based on the general communication system. For this, the Brazilian articles related to public administration published in *Scientific Periodicals Electronic Library (SPELL)* were gathered. The time frame included publications made since the Access to Information Law came into force (May 2012) until May 2020, covering eight years of academic output.

2. Material and Methods

Shannon and Weaver (1949) [6] developed the Information Theory (also called the “Mathematical Model of Communication”) to quantify the messages transmitted (at that time, mainly by telephone or telegraph), using a mathematical model in calculating the value of the information. Shannon was an employee at Bell Labs (where he developed his research) and his goal was to meet the technical requirements of his equation [7].

The logic of the mathematical model of communication comes from engineering and is used in areas such as physics, chemistry, biology, among others linked to the natural sciences [9]. However, there are authors, such as Schram (1954) [10], who defend the use of theory to understand interactions that contemplate the semantic dimension in the transport of information. Transposition to the social sciences appears strongly in the use of Shannon and Weaver’s general communication system (Fig. 1).

Fig. 1 illustrates the transport of information, starting from a sender of the message, driven by a transmitter (like an antenna, for example), reaching a receiver (like a radio) and, finally, being delivered to a recipient — who can be an individual or a social group. The signal is sometimes referred to as a code, and represents the link between sender and receiver based on rules shared by both [11]. The noise source interferes with the message emitted, and the process, therefore, is impaired [12].

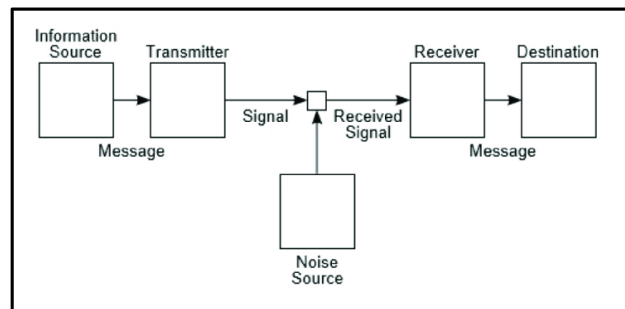


Fig. 1 Schematic diagram of general communication system.

The model, initially thought of as a support diagram for the mathematical calculation of information, was used repeatedly in social science works, despite several criticisms about its adaptation. The two creators of the Information Theory argued that the system was applicable only on the technical dimension, without considering the semantic issue [7, 9]. However, none of this prevented researchers from different areas from adapting the general communication system. Attneave (1959) [14] applied the foundations of the Information Theory and its general system in the field of psychology; Schramm (1954) [11] used the scheme to outline the research of mass communication and its circular character; Morin (2008) [15] listed the elements of Shannon and Weaver's model to explain the complexity of communication.

Along the same lines, Fenster (2015) [16] used the engineering ideas formatted by Shannon and Weaver to discuss transparency in government communication. The author expands the perspective of the mathematical theory of communication in this debate, incorporating semantic and behavioral elements in his argumentation.

Our article, while taking an approach similar to that of Fenster, does not discuss the need or likelihood of transparency in state communication. It is assumed that transparency is desirable and positive in this process, since our argument is based on social control. Social control is understood as the monitoring and evaluation in civil society of the acts practiced in the context of public administration. It is an integral part of the maturation of the democratic regime and is fundamental to a participatory society with influence and regulation in state management [13]. To exercise this control, civil society demands transparency.

Transparency can be defined as a set of information and communication processes between public entities and society, based on the elaboration and transmission of clear and objective information, crucial for the viability of social control [18]. The information

provided needs to be reliable, relevant and timely, so that the mechanisms for assuring the accountability of political actors are activated [19]. This means that the information needs to be clear and reliable to the data source, without barriers or interferences that could compromise its crystalline aspect. These interferences are described in the Information Theory as 'noise'.

In the mathematical approach to information, noise is an external interference, a distortion or an error, which increases the disorder of a message and, consequently, its uncertainty [20]. Shannon maintained that the message delivered to the recipient is the original message plus the noise [21]. In this logic, a system without noise assumes that information sent will be faithfully reproduced [22]. In the semantic approach, noise can also be interpreted as a barrier to understanding the meanings of the message. This barrier can be, for example, an inappropriate or unknown word [23]. The semantic dimension of information integrity involves the preservation of the complete message in the communication system, in order to avoid noise and, consequently, information asymmetry [24]. Santos et al. (2014) [12] also mention the asymmetry generated by noise (semantic and technical), and they provide examples of how it interferes with the reliability of the message and in its correct interpretation by the receiver. Such examples include: tone of voice; poor articulation; environmental noise; print quality; spelling, grammatical and handwriting errors; vocabulary used; excess of information transmitted; among others.

Our framework, presented in Fig. 2, places noise as a central aspect, bringing together other elements of the general system of Information Theory and amplifying them through dialogue with the available literature. This analysis model aims to identify and debate the barriers to transparent communication in public administration, in line with other researchers who have transposed the engineering scheme to the social sciences.

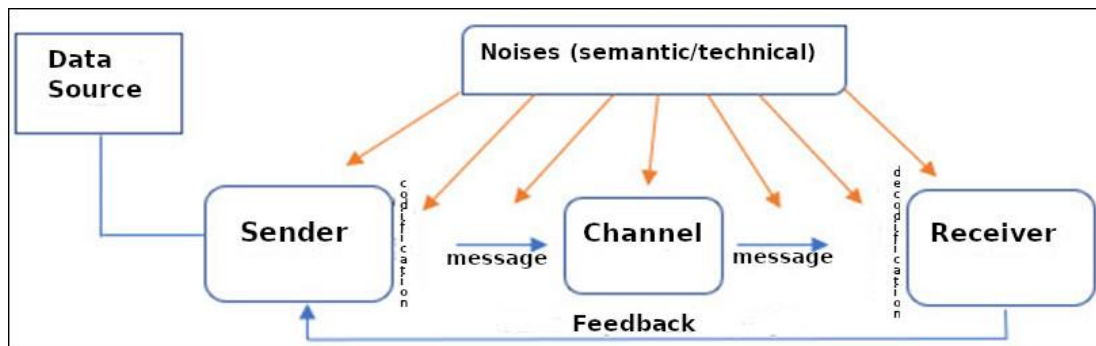


Fig. 2 Model inspired by the general system of information theory for the operationalization of content analysis.

Noises can occur at any time in the communication flow [25]. Regarding the reception of the message, Coelho Netto (1973) [26] states that, many times, the semantic noise can occur by code or repertoire, while the interpretation is hindered by factors such as diversity in the understanding of the sign, little mastery of the code, lack the receiver's experience, among other elements. The noise observed at the reception, however, may already have its origin in the emission. For this reason, the addition of the *feedback* component in the cybernetic section of the Information Theory [27] expanded the possibility of regulating the system, at the moment that the emission of message dialogues adjust to the attributes of the receivers. The model served as a basis for reading and interpreting a diverse array of publications on Brazilian public management, using a process of *meta-analysis*. Articles on transparency and government were searched in the SPELL database, since the electronic library is linked to the National Association of Graduate Studies and Research in Administration in Brazil. As already mentioned, for our time frame, we opted to filter the articles published after the Access to Information Law (LAI) came into effect in Brazil in May 2012 [28] until May 2020. Thus, 70 articles were identified, constituting the *corpus* of this research.

In the effort to identify and conceptualize of the most recurrent noises, Content Analysis [29] was used. Thematic categorization was carried out, with the creation of categories inductively [22]. The frequency survey, commonplace in Content Analysis, addressed the number of publications that discussed a particular

categorized topic. We then sought to measure the intensity of these noise categories in the eight years covered by the collected Brazilian academic production.

3. Results and Discussion

Four thematic categories were generated related to the idea of noise in communication: insufficient availability, difficult accessibility, selective disclosure and impaired decoding. The themes are composed of concepts of interference that goes against the transparency of the publicized information. The distribution of the articles collected is outlined in Table 1. It is possible for a given article to discuss one or more of the topics listed in the Content Analysis. The recording units were grouped as different types of noise, which were then connected to one of the four conceptualized categories in an inductive and subjective manner [22, 29] The categories listed are detailed in the following sections, addressed in a descriptive fashion and based on theoretical dialogue.

3.1 Insufficient Availability

When the availability of information is not sufficient, it means that the message communicated is incomplete, moving away from the reliability of the data source and configuring itself as a type of noise [24]. In the communicational flow for social control, insufficient availability is related to lack of timeliness, frequency or updating of data; lack of voluntary disclosure; and/or inefficient active and/or passive transparency.

Table 1 Categorized noises.

Noise category	<u>Insufficient availability</u>	<u>Difficult accessibility</u>	<u>Selective disclosure</u>	<u>Impaired decoding</u>
Concept	Information is not available in full, due to failures or lack of structure	Data are made available, but the way they are presented makes it difficult to understand	The data is deliberately evidenced or omitted for strategic purposes, compromising the integrity of the information	The receiver does not have the inputs expected for the correct interpretation of the message sent
Noises (as they appear in articles)	Inefficient active and/or passive transparency; lack of voluntary disclosure; lack of timeliness, frequency and/or data update	Visually confusing and/or difficult to navigate websites; difficult to understand language; data made available in a disorganized manner	Exhibition with filters that are of interest only to the public administration; omission of facts that show mismanagement, corruption or other unlawful acts	Inefficient communication due to lack of knowledge of the receiver (code/repertoire); lack of interest in the decryption effort
Nature of the noises	Technician	Technique/Semantics	Semantics	Semantics
Where it focuses on the system	Sender	Sender/Channel	Sender	Receiver
Frequency (number of articles addressing the topic)	26	25	16	10

Timely information allows citizens to participate more consciously in the public debate on resource allocation and other government measures [30]. The frequency and updating of data allow for the monitoring of State actions and policies (for example, public works) as they progress, something not always done in Brazil [31].

Voluntary disclosure, in turn, represents the provision of information that goes beyond the legal obligation. Several consulted authors, among the 26 articles grouped in this category, claim that many public managers were limited only to what is provided by law [32]. Other administrators did not even make the publication mandatory [33].

The obligation is linked to transparency that is active (when the State makes information public without the need for specific demand) and passive (when the public entity responds to a citizen's demand). Both forms evidenced flaws in Brazil, mainly the passive form, regulated by the Access to Information Law [34-36].

Voluntary disclosure can be scarce when there is no awareness of governance and disclosure [37], or due to the absence of an adequate structure. Some academic works point out the need to qualify public servants for the best availability of government data, which may occur due to lack of knowledge for the provision of the

service (38-40). Michener, Contreras and Niskier (2018) [35] suggest the creation of information commissions to manage availability in countries such as Mexico, Chile, United Kingdom, India, among other nations.

It is important to note that this category brings together (in theory) only the structural barriers to transparency, and for this reason the noise is considered to be of a technical nature. It is possible that the unavailability of information has a strategic objective, using filters and omissions for semantic purposes. These noises are categorized as "selective disclosure", cf. section 3.3 of this article.

3.2 Difficult Accessibility

Free and easy access to information and its comprehensibility are prerequisites for transparency, but the literature consulted reveals that this is not always the case in Brazil. Twenty-five articles address the data publicized were made available in a disorganized manner; the language was often difficult to understand; and many websites were not very intuitive and had a complex interface.

The organization of public administration data must be uniform and simple to view [34]. Also, the messages need to be publicized in ways that are understood by

the receivers so that the noise does not occur in their flow. Clarity, however, is commonly replaced by very technical language that is difficult to interpret upon reception.

Information on remuneration and benefits, especially from the judiciary, is often provided in closed formats and explained in language so garbled or mysterious that it is unintelligible — even for legal scholars. All of these challenges suggest the need for standardization and simplification [35].

Desirable access to information for social control also involves easy navigability on the internet. However, a considerable number of the websites researched in the literature included in the *corpus* of this study had malfunctions, broken links, inefficient research tools, absence of relevant information, absence of adaptability for people with special needs, among other problems listed in the reviewed scientific output [41-45].

3.3 Selective Disclosure

Selective disclosure differs from insufficient availability because it consists of a conscious act by the public issuer to make public or omit information about state management. It is, therefore, clearly a purposeful noise, and not a failure due to lack of qualification or structure.

The use of proper filters for the dissemination of what occurs in the State administration was addressed in 16 articles in the *corpus* of this research, but not all of the authors agree on its negative impact on social control. Klein, Klein and Luciano (2019) [46] argue that the selection process should be used to publicized only the timely content to citizens, without the need to show information on governmental administration in its entirety. This perspective is in line with the logic of appropriate openness in organizational communication, which proposes the strategic selection of what will be evidenced by a particular organization, especially in times of crisis [47].

Macadar, Freitas and Moreira (2015) [48] ponder this selection process, since there is a risk of compromising the amplitude attribute. The use of proprietary filters may omit data that lead to conclusions about mismanagement or corruption [17] or extol public management, in a strategy for self-promotion [49] and/or for political capitalization [50] based on the execution of public works.

One way to regulate selection is through the use of governance mechanisms applied to public administration [41, 49]. An example is the audit and inspection work carried out by independent institutions [37]. But the filters can also be calibrated based on the manager's culture to truly serve the public interest [41].

3.4 Impaired Decoding

This fourth noise category occurs more precisely at the end of the communication system developed by Shannon and Weaver. It refers to code and repertoire problems, cited by Coelho Netto [26], when the message is decoded at the reception. These barriers can cause distortions in the initial message or even interrupt the flow of communication.

The lack of understanding of the message, already addressed in this research as a consequence of an excess of technical terms or truncated language in the broadcast, also occurs due to the lack of citizen education. Ten papers, in the grouped scientific literature, point to deficiencies in the processing of information by a portion of civil society [51].

To avoid this problem, “citizens must have a sufficient level of education to acquire the knowledge and skills necessary to make use of the mechanisms of public transparency and, therefore, to know how to examine the available information” [3]. Often, not only formal education is lacking, but also civic education, necessary for members of civil society know their rights and have an interest in exercising social control [1].

The consulted literature lists some initiatives to change this situation. There are glossary tools on

government websites [52, 53]; courses offered to the population by courts and auditors [54]; and the inclusion of tax education in the Brazilian school curriculum [55].

4. Conclusion

The analysis of the *corpus* composed of 70 articles on transparency in the Brazilian public administration reveals that state information suffers, repeatedly, with distortions caused by noise in the general communication system. These noises were categorized as “Insufficient Availability”, “Selective Disclosure”, “Difficult Accessibility” and “Impaired Decoding”. The categories emerged from the reading of the *corpus* in Content Analysis and result in informational asymmetry.

The category “Insufficient Availability” was the most frequent among the analyzed publications. This recurrence can be explained by the lack of structure and/or qualification of public managers in Brazil. Without adherence to principles of governance, administrators are restrained in providing voluntary disclosure [37].

This constraint, however, can have strategic objectives. The noises, in this case, were gathered in the category “Selective Disclosure” and are not, unanimously, considered harmful to the management of the State in the consulted *corpus*. There are authors who argue that the use of filters to expose state acts can omit untimely information and reduce possible government weaknesses. On the contrary, other researchers contend that selection can set precedents for the publication of events that are of interest only to public management, which would undermine a just and well-founded form of social control.

In the general communication system, two categories of noise (“Insufficient Availability” and “Selective Disclosure”) affect the emission and are related to the provision of content in state advertising. For “Insufficient Availability”, the information is not available for technical reasons; for the “Selective

Disclosure”, the information is not available due to decisions made by public administrators. In the “Difficult Accessibility” category, the information is available, but it is not easily accessed. In this case, the use of technology is not necessarily a promoter of transparency in government-society interaction. In some cases, it enhances noise. In the category “Impaired Decoding”, the information is accessed, but it is not clearly understood or interpreted by the recipients.

Some of the articles in the *corpus* listed solutions — already applied or only suggested — to reduce interference, such as training courses, support tools, a commission to manage the availability of information, better formatting and clarity of data, governance instruments, among others. Just as Shannon included an element of error correction in his general communication system [10], these measures can, in an analogous way, reduce the noise in public management advertising, in order to contribute to citizen participation.

Future works may use the noises categorized in this text as elements for the analysis of the disclosure of organizational messages in different contexts. The methods and thematic categorizations of this research can be used, for example, to investigate failures in government communication during the Coronavirus pandemic. It is also possible to expand the results by gathering articles indexed in various research bases, as well as in electronic libraries established in other countries and other areas of knowledge.

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