

# Defining misinformation, disinformation and malinformation: An urgent need for clarity during the COVID-19 infodemic

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## Abstract

COVID-19 is an unprecedented global health crisis that will have immeasurable consequences for our economic and social well-being. Tedros Adhanom Ghebreyesus, the director general of the World Health Organization, stated “We’re not just fighting an epidemic; we’re fighting an infodemic”. Currently, there is no robust scientific basis to the existing definitions of false information used in the fight against the COVID-19 infodemic. The purpose of this paper is to demonstrate how the use of a novel taxonomy and related model (based upon a conceptual framework that synthesizes insights from information science, philosophy, media studies and politics) can produce new scientific definitions of mis-, dis- and malinformation. We undertake our analysis from the viewpoint of information systems research. The conceptual approach to defining mis-, dis- and malinformation can be applied to a wide range of empirical examples and, if applied properly, may prove useful in fighting the COVID-19 infodemic. In sum, our research suggests that: (i) analyzing all types of information is important in the battle against the COVID-19 infodemic; (ii) a scientific approach is required so that different methods are not used by different studies; (iii) “misinformation”, as an umbrella term, can be confusing and should be dropped from use; (iv) clear, scientific definitions of information types will be needed going forward; (v) malinformation is an overlooked phenomenon involving reconfigurations of the truth.

Keywords: COVID-19, infodemic, misinformation, disinformation, malinformation.

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# 1 Introduction

Coronavirus disease 2019 (COVID-19) is a deeply concerning pandemic that is alarming in both its severity and its spread (WHO 2020a). The initial growth of the virus was exacerbated by inaction and an absence of reliable evidence on how best to control the worsening situation (del Rio and Malani 2020). As COVID-19 spread, exaggerated information and a lack of trusted data hampered proper communication, delayed appropriate action and led to suboptimal decision making. The initial production and publication of vast amounts of valid and invalid messages led to an over-consumption of information, which was misleading, unsettling and confusing for a largely uninformed public (Ashrafi-rizi and Kazempour 2020a).

Worldwide, the behavior of the general public has a direct impact on the course of the virus through, for example, how rigorously social distancing rules are adhered to (Long 2020). The quantity and the quality of information that people receive affects their knowledge and perceptions, which (in turn) affects their actions in relation to prevention and control (Geldsetzer 2020). For instance, some people in the Republic of Iran wrongly believed false social media messaging that COVID-19 is curable with whiskey and honey, leading to the common belief that drinking high-proof alcohol would kill the virus. Sadly, by the end of March 2020, over 300 Iranians had died and more than 1,000 became sick after ingesting methanol because of this untrue information (Karimi and Gambrell 2020). Responding to the situation worldwide, Tedros Adhanom Ghebreyesus, the director general of the World Health Organization (WHO), stated, “We’re not just fighting an epidemic; we’re fighting an infodemic. Fake news spreads faster and more easily than this virus, and is just as dangerous.” (Naughton 2020). He added that, if the problem is not solved, then “we are headed down a dark path that leads nowhere but division and disharmony.”

Timely, accurate and transparent risk communications are essential during this pandemic because they determine whether the public is likely to trust messages from authorities more than they believe rumors and false information from other sources (Legido-Quigley et al. 2020). In the current COVID-19 crisis, the world desperately needs an enhanced communication strategy that provides the general population (particularly those most at risk of becoming ill) with actionable information for self-protection, including the identification of symptoms and clear guidance about how to seek and receive the appropriate treatment (Heymann and Shindo 2020). However, information sharing is currently hampered by a lack of readily available solutions to this unforeseen pandemic and an absence of appropriate clinical evidence to support effective public health communications (Wang et al. 2020). In this void, information systems worldwide are failing to respond quickly enough, allowing the COVID-19 infodemic to spread false, conflicting and conspiratorial messages.

The COVID-19 infodemic is an urgent issue requiring timely information systems research. Unreliable information is spreading rapidly across the globe via mobile phones, social media, the internet and other information systems (Kouzy et al. 2020). The speed and ease with which individuals can share information internationally has also meant that discussions can often move swiftly from the local to the global. Local interactions can, therefore, have global consequences that the originating individuals may not envisage or plan, with the con-

sequence that suppositions initially shared amongst intimate networks of individuals may quickly become part of international structures of proven and unproven beliefs (Kleineberg & Boguñá 2016). To halt the problems caused by the unconstrained COVID-19 infodemic, the WHO recently launched a new information system designed to combat misinformation about the virus (Zarocostas 2020).

Given the severity of the current situation, Ashrafi-rizi and Kazempour (2020) argue that attention must be paid to the production and dissemination of false information. To help classify messages spread by systems worldwide, the authors suggest the following typology: valid information; comforting information; perplexing information; misinformation; disinformation; shocking information; contradictory information; doubtful (untrusted) information; progressive information; postponed information; and confidential information. Whilst these categories may be helpful in analyzing information types during the COVID-19 pandemic, they were presented in a journal commentary that was not accompanied by a theoretical framework or direct reference to the appropriate academic literature. Therefore, this timely call to arms requires further scientific work to understand how this information classification approach can be successfully put into practice.

The initial responses to the COVID-19 infodemic have been from governments, social media platforms, clinicians and agencies specifically concerned with public health (Jandrić 2020). So far, these rapid responses have rarely been underpinned by formal, scientific work. Instead, they have been based upon “first-order thinking,” which is intuitive, informal and creative (Elbow 1994). If real solutions are to be found, the agenda needs to move beyond inspiration to the development of a form of “second-order thinking” that is committed to accuracy, strives for logic, questions assumptions and assesses the validity of proposed solutions. As an urgent agenda for information systems research, there is a pressing need for scientifically sound definitions of the types of false information currently being spread about COVID-19.

Given the newness of the COVID-19 infodemic, clarity is lacking about the logical differences between the concepts of mis-, dis- and malinformation (Søe 2018). To date, first-order thinking published in peer-reviewed journals has tended to focus on the COVID-19 infodemic as a problem caused by the sharing of “misinformation,” that is, “unintentionally false information” (Pennycook et al. 2020; Legido-Quigley et al. 2020; Garrett 2020; Mian and Khan 2020). At the periphery, a handful of commentators have argued that the real problem is not just unintentional falsity but the dissemination of “disinformation,” that is, “deliberately misleading information” (French & Monahan 2020; McCloskey and Heymann 2020). A fact sheet recently published by the Reuters Institute at the University of Oxford suggests that “malinformation,” that is, “reconfigured true information,” may also be an important but overlooked phenomenon in the current crisis (Brennen et al. 2020). Although mis-, dis- and malinformation are candidates for being classed as false information, the current situation suggests that the terms need clarifying and defining in operationally useful ways. Moreover, an appropriate taxonomy (that is, a scientific classification) is urgently required to support high-quality research and evidence-based action (Marradi 1990).

Currently, there is no robust scientific basis to the existing definitions of false information used in the fight against the COVID-19 infodemic. For instance, the definitional approach suggested by Ashrafi-rizi and Kazempour (2020) may be regarded as a useful topology but not a valid taxonomy. As this example suggests, the development of second-order thinking is desperately needed to produce a much-needed, robust categorization of types of COVID-19 information. For instance, the lack of clarity over the meaning of key terms has meant that disinformation is frequently being classified as misinformation, when the two are clearly different concepts. If the classification scheme underpinning the search for false messages is unscientific, errors will be common, and the fight against the COVID-19 infodemic will be less effective (Follette and Houts 1996). Given the gravity of the current situation, further scientific research is urgently required.

Taxonomy development is a complex process that has not always been adequately addressed in the information systems literature, often leaving classification systems to be developed informally using *ad hoc* methods (Nickerson, Varshney and Muntermann 2013). The problems posed by the COVID-19 infodemic suggest that a formal process of taxonomy creation is required. However, the complexity of issues involved in labelling COVID-19 data as false suggests that the development process will require multidisciplinary thinking, as it may not be possible to create the necessary theoretical framework from one discipline alone (Miles and Shipway 2020). In such situations, where a single theory cannot be foundational, Imenda (2014) suggests that researchers should develop a “conceptual framework” that synthesizes several theoretical perspectives into a structure that represents diverse ways of seeing. However, to be successful, conceptual frameworks must be limited in their scope to specific research problems and/or contexts, which implies that COVID-19 should be treated as a special case.

Conceptual frameworks published in academic papers are often accompanied by models that give a simplified representation of the reality being studied (Varian 2016). These conceptual models are designed to reveal the core features of what is being described, such as, in the current case, the ways in which false and harmful communications are disseminated. For instance, Wardle and Derakhshan (2018) represent the distribution of mis-, dis- and malinformation using a model of data creation, production and distribution. Sender–receiver models of this type are common in information systems research (Lin, Geng and Whinston 2005). However, further development of the Wardle and Derakhshan approach is required because their work was designed to be part of a training module for the United Nations Educational, Scientific and Cultural Organization (UNESCO) and does not meet the technical requirements for parsimonious model building. To develop their approach further, we outline a sender–receiver model of COVID-19 communications based upon Shannon and Weaver (1949). In doing so, we assume that senders can transmit false messages to receivers, who may or may not be aware they are receiving mis-, dis- or malinformation.

Given that understandable definitions of our information types exist and have been widely discussed in the academic literature, why do we need to go to the lengths of developing a conceptual framework, model and taxonomy in response to COVID-19? For instance, why is it not sufficient for information systems researchers to define “misinformation” as “uninten-

tionally false information” in their work on this topic? From a scientific perspective, for mis-, dis- and malinformation to be defined adequately, we need a robust definition of the concept of “information.” In practice, this creates two serious problems (Floridi 2013). First, there are many definitions of the concept of “information” in daily and technical usage, which suggests an appropriate one must be chosen. Second, Floridi (2013) argues that false information should be classed as “pseudo-information,” with the implication that misinformation should not be defined as a form of information at all. Therefore, in answer to our initial question about the complexity of our methods, we must develop a conceptual framework, model and taxonomy because mis-, dis- and malinformation are not easy concepts to define in operationally useful, scientifically valid ways. The timely production of conceptually sound definitions would help communications platforms and fact checkers worldwide improve their classifications of false COVID-19 information and help with the much-needed task of unifying their working methods (Brennen et al. 2020).

## 1.1 Overview of paper

The purpose of this paper is to demonstrate how the use of a novel taxonomy and related model (based upon a conceptual framework that synthesizes insights from information science, philosophy, media studies and politics) can produce new scientific definitions of mis-, dis- and malinformation pertinent to the COVID-19 infodemic. We undertake our analysis from the viewpoint of information systems research. In presenting our work, we perform the following tasks. First, we discuss our scientific methods for constructing our innovative definitions of mis-, dis- and malinformation. Next, we analyze various definitions of these information types to reach a conclusion about how best to define both. Third, we present our novel taxonomy and outline real definitions for the three forms of information. We conclude by discussing how the results of our scientific reconceptualization of these terms may be useful in the urgent fight against the COVID-19 infodemic, with the proviso that work is urgently required to promote their use in the current health crisis.

The publication of this paper is timely and our work makes several original contributions to the information systems literature. First, we present a conceptual framework (with an accompanying taxonomy and model) for robustly defining mis-, dis- and malinformation in the context of the COVID-19 infodemic. Next, our work may help researchers, governments, fact checkers and public health bodies to: (i) see clearly the main concepts related to the definition of mis-, dis- and malinformation in the current context; (ii) understand the benefits of adopting a scientific methodology when developing the concepts and the definitions that guide action; and (iii) organize the collection, interpretation and presentation of the data needed in the fight against false COVID-19 information (Vaezi and Javanmard 2020).

## 2 Conceptual methods

Although there are common sense definitions for each, no universally agreed, prepackaged research methods exist for formulating mis-, dis- and malinformation as concepts capable of guiding robust real-world research (Karlova and Fisher 2013). In response, we develop a methodological approach by following the scientific guide to concept formation in empirical sciences formulated by Hempel (1952). Following the approach that he suggested, we describe the phenomena of mis-, dis- and malinformation in terms of common concepts. In particular, we present a taxonomy of these information types based upon the vocabulary of everyday language but developed using scientific methods that allow the categorization of empirical data from the COVID-19 infodemic.

Following Hempel’s guidance, we define our terms using a distinction that he makes between “real” and “nominal” definitions. The former is a statement of the “essential characteristics” of an entity. For instance, humans are essentially rational animals. According to Hempel, essential natures may be expressed as equivalence sentences of the form:

$$x \text{ is a “specified entity” if and only if (iff) } x \text{ satisfies the conditions C.} \quad (1)$$

Here, C is a complex set of necessary and sufficient conditions for a specified entity to be classed as such. For instance,  $x$  may be defined as “information” iff  $x$  satisfies the conditions of: (i) being an object; and (ii) being informative (Buckland 1991). In setting such conditions, C may be specified theoretically, which solely requires a reflection on the meaning of its constituent expressions and no empirical investigation is necessary. For instance, the widely held philosophical view that information is “data” plus “meaning” requires no empirical clarification (Checkland and Scholes 1990). Alternatively, C can be specified in terms of real-world data, with reference to observed evidence. For instance, the behavior of some individuals suggests that the essence of information may be expressed in terms of “foraging” and “consumption,” which is an approach some people may find difficult to grasp (Pirolli and Card 1999).

In contrast to their real counterparts, nominal definitions specify expressions (the “definienda”) that are synonymous with certain other expressions (the “definiens”) whose meaning is already known. For instance, Hempel reports that the word “tiglon” is synonymous with the phrase “offspring of a male tiger and a female lion.” As this example suggests, a nominal definition has the form:

$$\text{Let the expression E2 be synonymous with the expression E1.} \quad (2)$$

In common practice, quotations marks are employed to denote the expressions being used. For instance, the term “infodemic” is a relatively new term that may be defined as the “rapid spread of information of all kinds, including rumors, gossip and unreliable information” (WHO 2018). According to Hempel, nominal definitions can differentiate concepts as separate classes or specific relationships between things. For instance, infodemic is a class of social phenomena separate from pandemic and has a specific relationship to the concept of

information that differs from any other relationship (Stahl 2006). As an observation, Hempel reports that traditional logic uses nominal definitions based upon classes or properties, whilst modern science defines things in terms of relationships or functions.

## 2.1 Technical criteria

In forming our concepts, we follow Hempel’s lead by building our conceptual framework scientifically. In doing so, we follow his three important technical criteria:

1. The condition of “*univocal eliminability*”: According to Hempel, scientific vocabularies contain expressions that define key concepts in terms of other expressions, which he calls “primitive terms.” Often, primitives are not defined within theoretical narratives themselves, although they usually have a theory-specific meaning attached to them. For instance, the term “information” may not be formally defined in a study of misinformation, but research continues with a particular, implicit meaning in mind (Bode and Vraga 2015). According to Hempel, the condition of univocal eliminability requires that, when used in a scientific theory, all “defined expressions” must be removable from nominal definitions so that they may be expressed purely in terms of primitives. For instance, often the expression “information” is not used as a primitive in definitions of mis-, dis- and malinformation and, consequently, should be replaced with more appropriate, primitive terms.

2. The requirement of “*syntactical determinacy*”: A definition must indicate the syntactical status of the expressions it defines (that is, it must make clear the logical form of the contexts in which the term is to be used). For instance, the word “information” can occur in two different logical forms, namely: “ $x$  is information about  $y$ ” and “ $x$  is information.” In the first context, which is illustrated by the sentence “6 foot tall is information about Peter,” the word “information” is a “relation term” that must be supplemented by two expressions (height and person) to form a sentence. In the second context, if we state “6 foot tall is information,” then the word “information” is being used as a “property term” only requiring one expression to form a sentence.

3. The need for “*justificatory sentences*”: Within a given theoretical system, certain kinds of nominal definitions require the prior establishment of appropriate non-definitional statements, which Hempel calls “justificatory sentences.” For instance, the definition of the melting point of a given chemical requires an explanation that justifies the definition in terms of the conditions that makes the definition correct (such as a specification of the required atmospheric pressure).

To ensure that our definitions are scientific, it is important that the above conditions are met.

### 3 Conceptual model

Central to our approach to modelling the processes underpinning the dissemination of mis-, dis- and malinformation is a focus on the role played by communications platforms. In recent years, stories about contemporary events have become dislocated from traditional media platforms (such as TV, radio and newsprint) to a range of digital platforms (such as Twitter, Facebook and Google) (Ekström, Lewis and Westlund 2020). In contrast to traditional news media, digital platforms provide technological resources that enable value-creating interactions between producers and consumers (Constantinides, Henfridsson and Parker 2018). For instance, social media platforms have enabled the rapid growth of the COVID-19 infodemic by enabling users to share communications in ways not possible via TV, radio and news media alone (Hua and Shaw 2020).

Because Shannon and Weaver (1949) focus on communications, we base our model on their work. Although popular, their approach has generated some intractable problems, including questions about the truth value of information and the ways in which receivers interpret the meanings of the messages they receive (Cornelius 2002). Whilst these general problems are not solvable here, we have created a new process model that meets the requirements of the research aims of this paper. As shown in Figure 1, we conceptualize the communication between senders and receivers as having the following features pertinent to the COVID-19 infodemic:

1. The communications channel between senders and receivers allows senders to create, and to send, messages that are disseminated to receivers via the communications platform.
2. Messages are based upon propositions that may be true or false. Messages and propositions can be “truth equivalent” (that is, either “both true” or “both false”) or not.
3. Receivers receive messages from the communications platform, not from the senders directly, which allows platforms to alter, block, and censor contents within set institutional constraints.
4. Receivers receive representations of sent messages that are generated by the platform, and they base their knowledge on these representations, not their underlying propositions.
5. Because propositions require external evidence to verify their truth value, they may be falsely represented in messages that do not contain a means of verifying their truth.
6. Platforms receive messages (“noise”) from external parties warning about mis-, dis- and malinformation being sent, which can interrupt the communications process.

As these features suggest, after a message is sent, the receiving platform acts as a dissemination node representing messages to receivers in its network (Constantinides et al. 2018). Although messages originate with senders, the platform controls how they are portrayed. For instance, Twitter limits tweets to 280 characters, which frames the ways in which in-

formation is portrayed, whilst Facebook and other social media platforms have allowed fake news to be presented in the same user formats as true stories (Zhang and Ghorbani 2020). In relation to mis-, dis- and malinformation, senders can consciously or unconsciously create false messages, but receiving platforms choose how they are represented. For instance, false messages can receive several responses, from being filtered to being flagged, censored or blocked (Gillespie 2018). By assuming that messages are represented by communications platforms rather than passing directly from senders to receivers, we are taking an information systems approach to our conceptual work (Hevner et al. 2004). Given the large volume of false information about COVID-19 that passes through social media platforms, the structure of our model seems pertinent (Singh et al. 2020).

[Figure 1 about here]

## 4 Analysis of information types

In this section, we outline specific conditions under which the concepts of mis-, dis- and malinformation may be defined scientifically using Hempel’s approach. When defining these terms, we must first explore the feasibility of using the concept of information as a *definiens* whose meaning is already known. To do this, we must choose a suitable definition of the term. For instance, we could adopt the “standard account” that defines “information” as “meaningful or representational data, which might or might not be true” (Fetzer 2004). In contrast, we could adopt the “strongly semantic” view that “information encapsulates truth, and hence that false information fails to qualify as information at all” (Floridi 2013, p.25). As these conflicting definitions suggest, before we can create nominal definitions for mis-, dis- and malinformation, we must decide whether we can legitimately use information as a *definiens* for these terms.

In everyday and academic use, false information is commonly referred to as information. Instead of joining the debate about whether the standard or the strongly semantic account is correct, we can invoke Hempel’s condition of univocal eliminability to solve the problem of whether we should define our terms in relation to this concept. Following the diktat of this condition, if it is operating as a definition and not a primitive, “information” should be removed from nominal definitions of mis-, dis- and malinformation so they can be expressed purely in terms of primitives. For instance, we could redefine misinformation to be “representational data that unintentionally misleads,” whilst disinformation could be refined as “representational data that intentionally misleads.” As it is possible to remove the concept of information from our definitions, we will do so to help meet the condition of univocal eliminability.

Now we have removed information, we must find a different way ahead if we are to express our terms scientifically. In response, our next step is to meet the requirement of syntactical determinacy by choosing appropriate logical forms for our types. As information is primarily disseminated and consumed to improve knowledge, we will select a logical form

that reflects this primary purpose. Within philosophy, two types of knowledge have been defined using the concepts of “propositions” and “categories” (Broudy 2017). In simple terms, “propositional knowledge” is based upon statements that can be verified as either true or false (Zagzebski 2017). In contrast, “categorical knowledge” is based upon the idea that we create knowledge by putting things into named classes or groups (Peruzzi 2018). To meet the requirement of syntactical determinacy, we suggest that the relational term “ $x$  is misinformation about  $y$ ” is an appropriate logical form for propositional knowledge, whilst the property term “ $x$  is misinformation” is an appropriate form for knowing categorically. Given our concern is defining mis-, dis- and malinformation scientifically, we will not explore the logical form of knowledge categories any further because our two information types have already been chosen and we are not seeking to analyze any further classes.

As a next step, to help build our syntactical scaffolding, we suggest the following relational form for propositional knowledge:

“message  $m$  embodies a proposition  $p$ ”, where  $p$  is either true or false. (3)

In formulating this statement, we assume that all messages contain (verbal, narrative or pictorial) statements that have a truth value. Given its importance in clarifying their logical structure, we will apply this relational form to our definitions of mis-, dis- and malinformation to meet the requirement of syntactical determinacy for both information types.

Based upon the analysis performed so far, we can now begin to formulate our two nominal definitions. As a start, we must acknowledge that the above working definition of “misinformation” as “representational data that unintentionally misleads” is questionable in terms of its contents. Although we have replaced “information” with “data” as the focal point of our definitions, the two terms are synonymous, so we are not satisfying the condition of univocal eliminability (Zins 2007). To avoid this error, we drop the term “data” from our definitions. As a replacement, we introduce the concept of a “proposition,” which fits with the structure of our conceptual model outlined in Figure 1. Because the meaning of this concept has been clarified within philosophy and other realms of discourse, there is no doubt that the concept of “proposition” can act as a primitive within our three definitions (Hylton 1984).

To develop our conceptual vocabulary further, Hempel suggests that we need to provide appropriate justificatory sentences for our definitions, which detail the conditions that make them correct. In response, we suggest the following:

1. Intention: Senders of messages have a subjective state of mind that allows them to choose whether to violate “scienter”, i.e., they can choose to have a “prior intent to do wrong.”
2. Representation: The ways in which messages represent their underlying propositions are dependent upon the operation of individual communications platforms.
3. Propositions: Propositions are embodied in messages that are transmitted by senders who may consciously or unconsciously misrepresent the truth value of these propositions.

4. Messages: Messages are communications transmitted from senders to receivers via communications platforms. They embody propositions that are represented as true or false.

Together, these justificatory sentences suggest that the dissemination of mis-, dis- and malinformation occurs within communications processes such as those suggested by the model outlined in Figure 1. As we chose to imply a communications process in our definitions, our conceptual framework, model and taxonomy are all constructed from an information systems perspective (Boland & Tenkasi 1995). An important feature of our information systems approach is that communication platforms can either be “passive” about (that is, will not respond to) or “active” about (that is, will take action about) any mis-, dis- or malinformation that senders request they represent to receivers. To facilitate parsimony, our taxonomy and novel definitions will assume that communication platforms are passive and permit all messages to reach receivers without any interference or alteration (Gerring 1999). Whilst this assumption does not reflect the everyday practice of social media platforms such as Twitter, it is necessary for forming parsimonious definitions for our information types (Lopez et al. 2020).

## 5 Taxonomy of information types

Our taxonomy is a scientific classification of our information types based upon our discussion of possible nominal definitions of mis-, dis- and malinformation, which are derived from our conceptual framework and reflect the communications process outlined in our model. Figure 2 presents the taxonomy, which has three levels to reflect our key concepts of intention, propositions and messages. At the primary level, senders decide whether to violate scienter by adopting an intention to deceive (Keeton 1958). At the next level down, propositions have a truth value, which, at the level below, senders can consciously or unconsciously reflect in their messages. Following this hierarchy, we can demonstrate a categorical difference between mis-, dis- and malinformation, with the concept of information acting as a reference case.

[Figure 2 about here]

Because of the complexities involved, the easiest way to describe the different categories of information presented in our taxonomy is to use Hempel’s notion of real definitions. Following his advice, we will present our real definitions in the following form:

Message  $m$  is a “specific information type” *iff*  $m$  satisfies the conditions C. (4)

Where C represents the following conditions:

1. D is an “intention to deceive” (D) or not ( $\neg D$ ) by the sender, and

2. proposition  $p$  is “truth equivalent” ( $\Leftrightarrow$ ) to message  $m$  or not ( $p \not\leftrightarrow m$ ).

Clarifying the meaning of the first condition, we define an “intention to deceive” as “sender’s *a priori* conscious plan to send receivers misleading messages that often (but not always) misrepresents their truth value.” Clarifying the meaning of our second condition, we assume that “if  $p$  is true and  $m$  is true,” then these variables have truth equivalence and “if  $p$  is false and  $m$  is false,” then these variables are also truth equivalent. Using this notation, we suggest the following real definitions:

$$m \text{ is “information” iff } \neg D \text{ and } p \Leftrightarrow m \tag{5}$$

$$m \text{ is “misinformation” iff } \neg D \text{ and } p \not\leftrightarrow m \tag{6}$$

$$m \text{ is “disinformation” iff } D \text{ and } p \not\leftrightarrow m \tag{7}$$

$$m \text{ is “malinformation” iff } D \text{ and } p \Leftrightarrow m \tag{8}$$

First, in the above list, a message may be classed as “information” if, and only if, there is no intention to deceive and the message and its embodied proposition are truth equivalent. Next, if there is no intention to deceive, but the message and the proposition are not truth equivalent, then the relevant classification is “misinformation.” Third, an intention to deceive and a lack of equivalence are required for a classification of “disinformation.” Finally, “malinformation” requires both intention and equivalence and often involves a repurposing of the truth value of information for deceptive ends. As these real definitions have been formulated using Hempel’s methods for constructing concepts in empirical research, we suggest that not only are they more informative than the existing “first-order” definitions in circulation but they also have the benefit of being scientifically sound.

## 6 Discussion

COVID-19 is an unprecedented global health crisis that will have immeasurable consequence for our economic and social well-being (Lee 2020). As the situation worsens and fears grow, uncertainty will increase, and the volume of false information may rise considerably (Ioannidis 2020). Whilst short-term interventions are being tried, from social lockdowns, fiscal stimulus packages, and urgent clinical trials for vaccines, to fact checking false news, no long-term solutions are yet in place. As time in this void increases, fear and anxiety is likely to worsen and disinformation will continue to spread (Wong, Leo and Tan 2020). As the world descends into an unknown state of being, it is vital that accurate information is shared about COVID-19 and the ways in which governments, society and individuals can work together to fight its impact (Budish 2020).

To date, technology platforms have been acting to halt the rise in false information shared online, action that ranges from preventing advertisements that reference the virus, to direct-

ing users to WHO or local health service websites, and removing all content from unverified sources. Despite these actions, examples of fake or misleading news about the coronavirus are still easy to find (Hollowood and Mostrous 2020). More worryingly, misinformation may be as much of a challenge to democracy as to population health (EU External Action Service 2020). In response, our novel definitions could give digital platforms, fact checkers and other agencies a scientific base from which to govern mis-, dis- and malinformation (Hameleers and van der Meer 2019). Although alternative ways of categorizing false COVID-19 information exist, the current practice is to label them all under the umbrella term of “misinformation.” In response, our taxonomy could make infodemic analysis more robust and eventually help the public to think more clearly about the types of unreliable information they encounter (Pennycook et al. 2020). For instance, better definitions could help avoid the problem of social media platforms wrongly deleting or flagging suspect posts, an action that makes some users suspicious and may reinforce conspiracy theories (Gonçalves-Sá 2020). For instance, proper classification could avoid satire being censored because of inadequacies in the ways in which COVID-19 information is labelled (Levi et al. 2019).

From an information systems perspective, the current global crisis is a call to arms to promote the use of digital and other technologies for the common good whilst taking measures to quickly eradicate the bad (Harcup 2020). In delivering this new agenda, special attention should be paid to solving the problems created by the industrial-scale production of mis-, dis- and malinformation (Moreira and Eiró-Gomes 2019). In this paper, we endeavour to deliver timely research from an information systems perspective by presenting a conceptual framework (and accompanying model) that underpins the building of appropriate scientific definitions of the essential natures of our information types. As the usefulness of our definitions depends upon their success in use, we now demonstrate their application using four real-world examples.

#### Example One: Information

$p$  states that “On 27 March 2020, there were 509,164 confirmed COVID-19 cases worldwide.” These data appeared in WHO (2020b) Coronavirus disease 2019 (COVID-19): Situation report 67 and is “true.” We can safely assume that the WHO had no intention to deceive in messages they sent based upon this proposition. As a result, this example may be classed as “information” because  $\neg D$  and  $p \Leftrightarrow m$ .

#### Example two: Misinformation

$p$  states that “Dettol is proven against human coronavirus.” This proposition was widely disseminated on Facebook and other social platforms as true. The spread of false social media messages was probably unintentional because this antibacterial product did have some effectiveness against a previous strain of coronavirus, which sharers probably believed incorrectly was the same thing as COVID-19 (Sharma 2020). Therefore, this example may be classed as “misinformation” because  $\neg D$  and  $p \not\Leftrightarrow m$ .

#### Example three: Disinformation

$p$  states that “COVID-19 is caused by 5G.” This false statement has circulated widely via news and social media channels. Apparently, the message originated with a medical practi-

tioner who had been charging for consultations in alternative medicine, the 5G claim may be an intentional deceit to convince patients to distrust mainstream medical practices. As a result, this example may be classed as “disinformation” because  $D$  and  $p \not\Leftarrow m$ .

#### Example four: Malinformation

$p$  states that “Even with the corona virus panic buying, no one wants to eat vegan food.” This example, suggested by Brennen et al. (2020), appeared as part of a Facebook post showing a picture of empty supermarket shelves with piles of vegan food left unbought in the middle of the emptiness. In terms of the picture, the proposition that no-one wanted the vegan food is true. However, the overall message is misleading because the image came from a grocery store in Texas in 2017, just ahead of Hurricane Harvey. According to Brennen et al. (2020), the picture of the grocery store was “repurposed” so that a truth from one context (Hurricane Harvey) was used to deceive in another (COVID-19). Therefore, this example may be classified as “malinformation” because  $D$  and  $p \Leftrightarrow m$ .

These examples suggest that our conceptual approach to defining mis-, dis- and malinformation may be applicable to empirical cases and, if applied properly, useful in fighting the COVID-19 infodemic. To do so will require practical ways of working that classify information types using our primitive concepts of propositions, messages and intentions. For instance, a fact-checking organisation or digital platform could begin the classification process by identifying the core propositions in the COVID-19 messages they chose to analyze. Next, they could record whether the messages sampled have truth equivalence with the propositions they contain. The task of signing intention is more difficult because the motivations of originators are usually unknown (Søe 2018). Nevertheless, the source of the message, the sentiments expressed or the framing of the communication could all yield clues as to whether there is a conscious intention to deceive (Medford et al. 2020). If we acknowledge that assigning intention is difficult but not operationally impossible, then the real definitions present here could be populated with data on  $D$  and  $p \Leftrightarrow m$  to classify each message analyzed as mis-, dis- or malinformation.

As our approach is likely to be workable in practice, we should ask how exactly our conceptual apparatus can help in the fight against the COVID-19 infodemic? When answering this question, a factsheet produced by the Reuters Institute at the University of Oxford may be helpful because it presents the results of a rapid review of the types, sources and claims of COVID-19 misinformation (Brennen et al. 2020). In this study, the Oxford team analyzed 225 pieces of information published in English between January and the end of March 2020 that were rated as false or misleading by fact checkers. A majority (88%) of their sample appeared on social media platforms, with a small number on TV (9%), published by news outlets (8%) or appearing on other websites (7%). Given difficulties in assessing whether information creators intend to deceive or not, the authors were unable to identify mis-, dis- or malinformation in the ways we define here. Instead, they use the term “misinformation” throughout their factsheet to “refer broadly to any type of false information – including disinformation.” According to the authors, only 38% of their sample was completely fabricated, with no examples of deep fakes being found.

The Oxford team also make a novel contribution to the debate about misinformation and COVID-19 by finding that 59% of the false information they sampled involved various forms of “reconfiguration,” where “existing and often true information is spun, twisted, re-contextualized, or reworked.” Within this reconfiguration group, the authors identified three subtypes. The most common contained some true information, but the details were reformulated, selected and recontextualized in ways that made them false or misleading. For instance, one widely shared post offered medical advice from someone’s uncle, combining both accurate and inaccurate information about how to treat and prevent the spread of the virus. The next most common form were images or videos labelled or described as being something other than they were, such as the aforementioned vegan food example of malinformation. Finally, the sample included a small number of manipulated images and videos, primarily using simple, low-tech editing techniques. As an example, one video included images of bananas edited into a news segment to suggest that the fruit can prevent or cure COVID-19.

From the perspective of our conceptual approach, the findings in the Reuters Institute factsheet are informative because they imply that: (i) misinformation, defined as  $\neg D$  and  $p \not\Leftarrow m$ , seems of little importance; (ii) disinformation, defined as  $D$  and  $p \not\Leftarrow m$ , is not as prevalent as the non-COVID-19 social media literature suggests; and (iii) malinformation, defined as  $D$  and  $p \Leftrightarrow m$ , may be an overlooked but important phenomena. Together, these implications suggest the following.

1. Analyzing all types of information is important in the battle against the COVID-19 infodemic.
2. A scientific approach is required so that different methods are not used by different studies.
3. “Misinformation” as an umbrella term is confusing and should be dropped from use.
4. Clear, scientific definitions of information types are needed going forward.
5. Malinformation is an overlooked phenomenon involving reconfigurations of the truth.

These implications suggest that, in the face of the unforeseen COVID-19 crisis, the rush to stop the growing infodemic promoted widespread first-order thinking, which is now obscuring (not clarifying) the problems being experienced (Campbell et al. 2007). In relation to the uncertainty and confusion caused by the global pandemic, central governments are making forceful interventions and using coercion to achieve public health goals (Wursten 2020). Mirroring this approach, many digital platforms are now asserting their own vigorous solutions because reliance on flagging, alternative facts and user cognition is not stopping the viral spread of false beliefs (Barrera et al. 2020). For instance, most social media platforms are now censoring bad actors, even though censorship may not be a tenable solution to the widespread dissemination of false information in the long run (Fitzgerald 1997). Given this situation, the COVID-19 infodemic is a global problem that needs instant and robust solutions.

## 7 Conclusions

The COVID-19 infodemic has stimulated a rapid global response that is currently in the early stages of an overall process of emergency management (Xue and Zhong 2005). As the situation unfolds and new ways of working are tried, lessons will be learnt. To date, initial take-aways seem to be that: (i) the infodemic is unprecedented in its size and velocity; (ii) unexpected forms of false information are emerging daily; and (iii) no global consensus exists on how best to classify the types of false messages being encountered. Moreover, there may be an elephant in the room because much of the false information spread so far has not been unreliable health advice but is state-disseminated propaganda designed for destabilizing political ends (Sukhankin 2020). For this reason alone, governments, academics, digital platforms, fact checkers, concerned institutions and the public urgently need a shared understanding of what is meant by the terms mis-, dis- and malinformation. Without a scientific understanding of these concepts, there is a danger of significant democratic consequences from this global health crisis. The information systems research community can actively work to help avoid this.

# Figures

Figure 1: Communications channel between senders and receivers

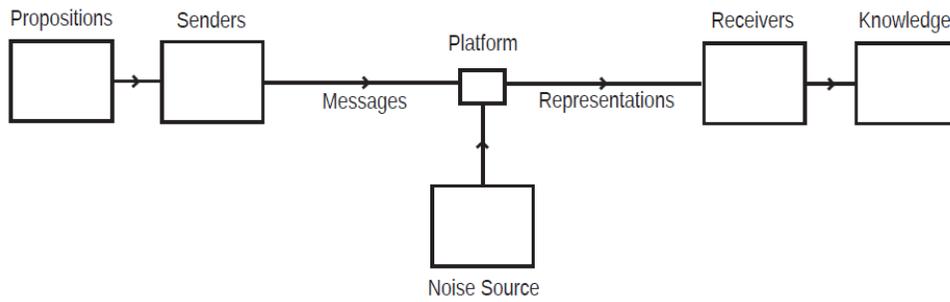
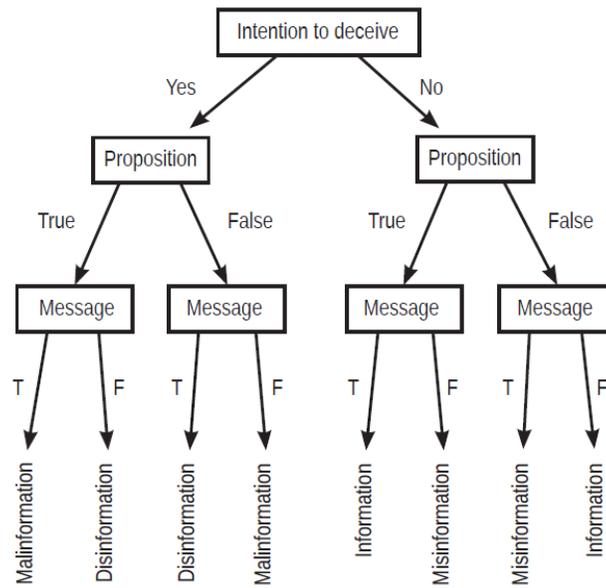


Figure 2: Taxonomy of information types



## References

Ashrafi-rizi H, Kazempour Z (2020) Information typology in coronavirus (COVID-19) crisis; a commentary. *Arch. Acad. Emerg. Med.* 8(1):e19.

Ashrafi-rizi H, Kazempour Z (2020a) Information diet in Covid-19 crisis; a commentary. *Arch. Acad. Emerg. Med.* 8(1): e30.

Barrera O, Guriev S, Henry E, Zhuravskaya E (2020) Facts, alternative facts, and fact checking in times of post-truth politics. *J. Public Econ.* 182:104123.

Bode L, Vraga EK (2015) In related news, that was wrong: the correction of misinformation through related stories functionality in social media. *J. Commun.* 65(4):619–638.

Boland RJ Jr, Tenkasi RV (1995) Perspective making and perspective taking in communities of knowing. *Organ. Sci.* 6(4):350–372.

Brennen JS, Simon F, Howard PN, Kleis Nielsen R (2020) Types, sources, and claims of COVID-19 misinformation. Oxford: Reuters Institute Fact Sheet.

Broudy HS (2017) Types of knowledge and purposes of education in Spiro, R. J., Anderson, R. C., & Montague, W. E. (eds.). *Schooling and the Acquisition of Knowledge* (Routledge), 1–17.

Buckland MK (1991) Information as thing. *J. Am. Soc. Inf. Sci.* 42(5):351–360.

Budish EB (2020) R<sub>i</sub> 1 as an economic constraint: can we 'expand the frontier' in the fight against Covid-19? Working paper, University of Chicago, Becker Friedman Institute for Economics, Chicago.

Campbell JM, Edwards MS, Horswill MS, Helman S (2007) Effects of contextual cues in recall and recognition memory: The misinformation effect reconsidered. *Br. J. Psychol.* 98(3):485–498.

Checkland P, Scholes J (1990) *Soft Systems Methodology in Action* (Springer).

Constantinides P, Henfridsson O, Parker GG (2018) Introduction – platforms and infrastructures in the digital age. *Inf. Syst. Res.* 381–400.

Cornelius I (2002) Theorizing information for information science. *Annu. Rev. Inf. Sci. Technol.* 36(1):392–425.

del Rio C, Malani PN (2020) COVID-19 – new insights on a rapidly changing epidemic. *JAMA*.

Ekström M, Lewis SC, Westlund O (2020) Epistemologies of digital journalism and the study of misinformation. *New Media Soc.* 22(2):205–212.

Elbow P (1994) Teaching two kinds of thinking by teaching writing. *Re-thinking reason: New perspectives in critical thinking* 25–32.

EU External Action Service (2020) EEAS special report update: short assessment of narratives and disinformation around the COVID-19 pandemic. <https://euvsdisinfo.eu/eeas-special-report-update-short-assessment-of-narratives-and-disinformation-around-the-covid-19-pandemic/> (Accessed 10 April 2020).

Fetzer, J. H. (2004). Information: Does it have to be true? *Minds and Machines*, 14(2), 223-229.

Fitzgerald MA (1997) Misinformation on the internet: applying evaluation skills to online information. *Teach. Libr.* 24(3):9.

Floridi L (2013) *The philosophy of information.* (OUP, Oxford).

Follette WC, Houts AC (1996) Models of scientific progress and the role of theory in taxonomy development: a case study of the DSM. *J. Consult. Clin. Psychol.* 64(6):1120.

French M, Monahan T (2020) Dis-ease surveillance: how might surveillance studies address COVID-19? *Surveil. Soc.* 18(1):1–11.

Garrett L (2020) COVID-19: The medium is the message. *Lancet* 395(10228):942–943.

Geldsetzer P (2020) Knowledge and perceptions of coronavirus disease 2019 among the general public in the United States and the United Kingdom: A cross-sectional online survey. medRxiv.

Gerring J (1999) What makes a concept good? A criterial framework for understanding concept formation in the social sciences. *Polity* 31(3):357–393.

Gillespie T (2018) *Custodians of the Internet: Platforms, Content Moderation, and the Hidden Decisions That Shape Social Media.* (Yale University Press, London.).

Gonçalves-Sá J (2020) In the fight against the new coronavirus outbreak, we must also struggle with human bias. *Nat. Med.* 26(3):305.

Hameleers M, van der Meer TG (2019) Misinformation and polarization in a high-choice media environment: how effective are political fact-checkers? *Comm. Res.* 0093650218819671.

Harcup T (2020) Ethical journalism for the public good in Harcup T (ed.) *What's the Point of News?* (Palgrave Macmillan, Cham), 75–88.

Hempel CG (1952) *Fundamentals of Concept Formation in Empirical Science*, Vol. 2, No. 7. (University of Chicago Press, Chicago).

Hevner AR, March ST, Park J, Ram S (2004) Design science in information systems research. *MIS Q.* March 1, 75–105.

Heymann DL, Shindo N (2020) COVID-19: What is next for public health? *Lancet* 395(10224):542–545.

Hollowood E, Mostrous A (2020) The infodemic: fakenews in the time of C-19. *Tortoisemedia.com*. (Accessed 10 April 2020).

Hua J, Shaw R (2020) Corona virus (COVID-19) “infodemic” and emerging issues through a data lens: The case of China. *Int. J. Environ. Res. Public Health* 17(7):2309.

Hylton P (1984) The nature of the proposition and the revolt against idealism. *Philos. History* November, 375–97.

Imenda S (2014) Is there a conceptual difference between theoretical and conceptual frameworks? *J. S. Sci.* 38(2):185–

Ioannidis JP (2020) Coronavirus disease 2019: the harms of exaggerated information and non-evidence-based measures. *Eur. J. Clin. Invest.* March 23.

Jandrić P (2020) Postdigital research in the time of Covid-19. *Postdigital Sci. Educ* March 1–6.

Karimi N, Gambrell J (2020) In Iran, false belief a poison fights virus kills hundreds. *Associated Press*. 27 March 2020.

Karlova NA, Fisher KE (2013) A social diffusion model of misinformation and disinformation for understanding human information behaviour. *Information Research*, 18(1).

Keeton P (1958) Fraud: the necessity for an intent to deceive. *UCLA Law Rev.* 5:583.

Kleineberg, K. K., & Boguñá, M. (2016) Competition between global and local online social networks. *Scientific reports*, 6, 25116.

Kouzy R, Abi Jaoude J, Kraitem A, et al. (March 13, 2020) Coronavirus Goes Viral: Quantifying the COVID-19 Misinformation Epidemic on Twitter. *Cureus* 12(3): e7255. doi:10.7759/cureus.7255

Lee TL (2020) Global health in a turbulence time: a commentary. *Asian J. WTO Int. Health Law Policy* 15(1):27–60.

Leidner, D. E. (2020). Editorial Reflections: Lockdowns, Slow Downs, and Some Introductions. *Journal of the Association for Information Systems*, 21(2), 10.

Legido-Quigley H, Asgari N, Teo YY, Leung GM, Oshitani H, Fukuda K, et al. (2020) Are high-performing health systems resilient against the COVID-19 epidemic? *Lancet* 395(10227):848–850.

Levi O, Hosseini P, Diab M, Broniatowski DA (2019) Identifying nuances in fake news vs. satire: using semantic and linguistic cues. *arXiv preprint arXiv:1910.01160*.

Lin L, Geng X, Whinston AB (2005) A sender-receiver framework for knowledge transfer. *MIS Q.* June 1, 197–219.

Long NJ (2020) From social distancing to social containment: reimagining sociality for the coronavirus pandemic. *Med. Anthropol. Theory*.

Lopez CE, Vasu M, Gallemore C (2020) Understanding the perception of COVID-19 policies by mining a multilanguage Twitter dataset. *arXiv preprint arXiv:2003.10359*.

Marradi A (1990) Classification, typology, taxonomy. *Qual. Quan.* 24(2):129–157.

McCloskey B, Heymann DL (2020) SARS to novel coronavirus – old lessons and new lessons. *Epidemiol. Infect.* 148, Feb 5,148:e22. doi: 10.1017/S0950268820000254.

Medford RJ, Saleh SN, Sumarsono A, Perl TM, Lehmann CU (2020) An “infodemic”: leveraging high-volume Twitter data to understand public sentiment for the COVID-19 outbreak. *medRxiv*, January 1.

Mian A, Khan S (2020) Coronavirus: the spread of misinformation. *BMC Med.* 18(1):1–2.

Miles L, Shipway R (2020) Exploring the COVID-19 pandemic as a catalyst for stimulating future research agendas for managing crises and disasters at international sport events. *Event Manag.* 1–41. <https://doi.org/10.3727/152599519X15506259856688>

Moreira V, Eiró-Gomes M (2019) Information, misinformation, disinformation: the role of communication professionals in liquid modernity. Emerald Publishing, Bingley, West Yorkshire.

Naughton J (2020) Fake news about Covid-19 can be as dangerous as the virus. *The Guardian* 14 March.

Nickerson RC, Varshney U, Muntermann J (2013) A method for taxonomy development and its application in information systems. *Eur. J. Inform. Syst.* 22(3):336–359.

Pennycook G, McPhetres J, Zhang Y, Rand D (2020) Fighting COVID-19 misinformation on social media: Experimental evidence for a scalable accuracy nudge intervention. *PsyArXiv*, 17 Mar. 2020. Web.

Pirolli P, Card S (1999) Information foraging. *Psychol. Rev.* 106(4):643.

Peruzzi A (2018) Categories: turning a list of issues into a system. *Categories: Histories and Perspectives* 93:239.

Shannon CE, Weaver W (1949) *The mathematical theory of communication* (University of Illinois Press, Champ.), 117.

Sharma R (2020) Coronavirus conspiracy theories: Why there’s so much misinformation around Covid-19, and why the fake news is so damaging. *Independent.com*, 2nd March 2020, 4:45 pm.

Singh L, Bansal S, Bode L, Budak C, Chi G, Kawintiranon K, et al. (2020) A first look at COVID-19 information and misinformation sharing on Twitter. *arXiv preprint arXiv:2003.13907*.

Søe SO (2018) Algorithmic detection of misinformation and disinformation: Gricean perspectives. *J. Doc*, 12 March.

Stahl BC (2006) On the difference or equality of information, misinformation, and disinformation: a critical research perspective. *Informing Sci.* 9, July.

Sukhankin S (2020) COVID-19 as a tool of information confrontation: Russia’s approach. *School Public Pol. Pub.* 13, April 3.

Vaezi A, Javanmard SH (2020) Infodemic and risk communication in the era of CoV-19. *Adv. Biomed. Res.* 9(1):10.

Varian HR (2016) How to build an economic model in your spare time. *Am. Econom.* 61(1):81–90.

Wang LS, Wang YR, Ye DW, Liu QQ (2020) A review of the 2019 novel coronavirus (COVID-19) based on current evidence. *Int. J. Antimicrob. Agents* 105948, March 19.

Wardle C, Derakhshan H (2018) Thinking about “information disorder”: formats of misinformation, disinformation, and mal-information. Ireton C, Posetti J, eds. *Journalism, ‘Fake News’ & Disinformation* (UNESCO), 43–54.

Wong JE, Leo YS, Tan CC (2020) COVID-19 in Singapore—current experience: critical global issues that require attention and action. *JAMA*, 323(13):1243-1244. doi:10.1001/jama.2020.2467.

World Health Organization (2018) Managing epidemics: key facts about major deadly diseases. (World Health Organization, Geneva).

World Health Organization (2020a) Coronavirus disease 2019 (COVID-19): situation report, 51. (World Health Organization, Geneva).

World Health Organization (2020b) Coronavirus disease 2019 (COVID-19): situation report, 67. (World Health Organization, Geneva).

Wursten H (2020) There is a system in the madness. the 7 mental images of national culture and the corona virus. *J. Intercult. Manage. Ethics* 3(1):7–17.

Xie B, He D, Mercer T, Wang Y, Wu D, Fleischmann KR, et al. (2020). Global health crises are also information crises: A call to action. *J. Assoc. Inform Sci. Technol.*

Xue L, Zhong KB (2005) Classification of types, levels and stages for emergencies: managerial foundation of government emergency response system. *Chinese Public Admin.* 2.

Zagzebski L (2017) What is knowledge? *The Blackwell guide to epistemology.* Blackwell, London. 92–116. Zarocostas J (2020) How to fight an infodemic. *Lancet* 395(10225):676.

Zhang X, Ghorbani AA (2020) An overview of online fake news: characterization, detection, and discussion. *Inf. Process. Manag.* 57(2):102025.

Zins C (2007) Conceptual approaches for defining data, information, and knowledge. *J. Am. Soc. Inf. Sci Technol.* 58(4):479–493.