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Does seeing entail believing? Visualising information during societal crises

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DOES SEEING ENTAIL BELIEVING? VISUALISING INFORMATION DURING SOCIETAL CRISES

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ABSTRACT

Despite the shared belief that information visualisations are immune to manipulation, as visual stimuli, they "*are no different from words in this regard, for any means of communication can be used to deceive*" (Tufte, 1983). This paper discusses the power of information visualisation in engendering "*a narrative experience*" (Segel et Al., 2010) that cannot be considered politically neutral (Boehnert, 2016). In this sense, it can be compared to the concept of "*tropes*" (Haraway, 1988) which are narrative tools transmitting political and social agendas. The paper explores the existing literature addressing the circulation of information disorders (Wardle & Derakhshan, 2019) on social media platforms when supported by information visualisations. The starting point is that the complexity of the topic, its interdisciplinarity, and the dense availability of reflections call for a crisis, a "*fracture line*" (Foucault, 1969), that can lead to the unveiling of omitted dimensions. The exploration enabled the identification of a space for reconsidering critical approaches to information visualisation circulating on social media by defining literacy resources that combine terminologies, views, methodologies and approaches from diverse disciplines and fields.

INTRODUCTION

Information disorders, social media platforms, societal crises and information visualisations. Social media platforms are increasingly mediating how we access information in a way that may facilitate the circulation of falsehoods (Ceron et Al., 2020). This phenomenon is related to the problem of "*information disorders*" (Wardle & Derakhshan, 2019), namely those kinds of bad information such as fake news, propaganda, conspiracies, disinformation, misinformation, and malinformation circulating within such digital ecosystems. Social media platforms, as "*dominant infrastructural and economic models of the social web*" (Helmond, 2015), can be used to influence social perception and narratives, especially about controversial issues (Cinelli, 2020). The concept of *societal crises* addressed in this paper refers to those situations of significant social change (Prooijen & Douglas, 2017) on which social actors disagree (Venturini, 2010). Similarly, the online circulation of information visualisation directly affects society (Nærland, 2021), a fortiori when used to inform audiences about social issues. As communication instruments, they embody values, ideologies, and perspectives and often serve political priorities and agendas (Boehnert, 2016).

The matter of the reliability of information visualisations circulating online becomes clear when analysing the case of COVID-19. During the pandemic, there was a significant shift towards human activities being deeply immersed in the internet, and a flood of cultural, educational, and informative visualisations have been produced, consumed, and shared online. The World Health Organisation (2020) defined such threatening complexity as an "*infodemic*", namely an "*excessive amount of information about a problem*" (ibidem) which encourages the "*spread of

misinformation, disinformation and rumours during a health emergency" (ibidem).

As Drucker (2020) stated: "*the Covid crisis has generated a real need to understand and communicate vital information about data, models, and outcomes. We needed it to persuade, understand current conditions, and predict future outcomes. There has never been a moment where information visualisation has been thrust so much into the centre of everyday life*". In this context of significant proliferation, information visualisations can be crafted to convey specific narratives (Atherton, 2021) and aimed at "*engaging citizens around a wide range of social issues*" (Dörk et Al., 2013). Figure 1 is an example of the responsibility visualisations have in such critical times. As observed by Shelton (2020), the graph shows the decreasing number of new COVID-19 cases from April 28 to May 9, 2020. However, the x-axis is not ordered by date but by the total value per day, making the visual comparison useless and -even worse- suggesting wrong information. Another example along these lines is the collection of pie charts analysed by Doan (2021), which misuses visual proximity to minimise the COVID-19 death rate compared to SARS and MERS (see Figure 2). Moreover, the time variable is excluded from the visualisation, which is crucial when studying the effects of a disease.

Therefore, understanding the effects of information visualisations during a social crisis is critical in taking appropriate actions to mitigate the situation and reduce personal and community risk. In this context, access to quality information is essential for citizens to engage in democratic processes.
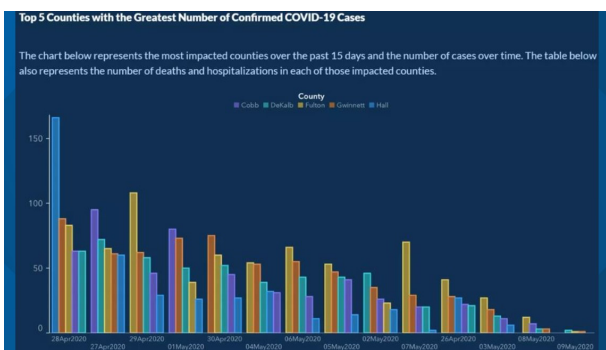

Figure 1 – Top 5 countries with the most significant number of confirmed COVID-19 cases. Georgia Department of Public Health, 2020.

Albeit the literature has consistently addressed the challenges arising from the rhetorical nature of information visualisations (e.g. Hullman & Diakopoulos, 2011, Offenhuber, 2020, Lee et Al., 2021, Muehlenhaus, 2013, Engebretsen & Kennedy, 2020), as well as the circulation of information disorders on social media platforms (e.g. Pavliuc & Dykes, 2020, Cinelli et Al., 2020, Tagliabue et Al., 2020, Blevins et Al., 2021)

and social issues (Marres, 2015, Venturini 2010), little has been written on the overlapping of these themes. How do information visualisations support the circulation of information disorders on social media platforms during specific societal crises? This paper concentrates on this gap and aims to collect relevant evidence from diverse disciplines to outline a new space for possibilities.
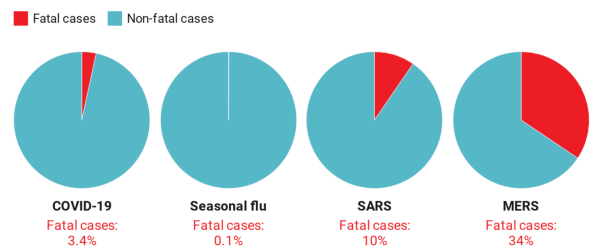

Figure 2 – COVID-19 compared to seasonal flu. Wolfson E., 2020.

METHODOLOGY

Reviewing the context. The previous paragraphs introduced the problem and the controversy (Venturini, 2010) surrounding the research, which elicits the consequent need to explore the evidence and fields involved. Stemming from contextual review (Gray & Malins, 2004) in design research, this activity invokes disciplinary and non-disciplinary sources to define the extent of the inquiry and the state of the relevant knowledge base to date. This process contributes to both the identification of the research problem and the research of that problem through the methodology (ibidem).

What is the role of information visualisations in the circulation of information disorders on social media platforms during societal crises?

This overarching question defines the direction in which to orient the process of "*thematic literature review*" (Muratovski, 2016) aimed at examining various perspectives from different fields around the phenomenon framed in the introduction.
Such process is articulated around three main actions drawing from the approach of grounded theory: 1) the collection of evidence through the identification of keywords and disciplinary areas; 2) the analysis of the information collected by "*systematically extracting ideas, theories, concepts and methodological assumptions*" (Hart, 1998) proposed by other researchers and plausible for the new inquiry; 3) the synthesis, intended as the capacity to re-assemble and make "*connections between parts identified in the analysis*" (Hart, 1998).
Following the order of the three main actions aforementioned, and drawing from the steps theorised

COLLECTION ANALYSIS SYNTHESIS

1
SINGLING-OUT
keywords identification
↓
Search vocabulary

2
DELVING-INTO
searching for literature

Scientific literature   Grey literature

Select relevant evidence

3
TIDYING-UP
organizing the literature
↓
Assembling
folders of themes and sub-themes

4
LOOKING-INTO
analyzing the literature
↓
Synthesising
Annotations, diagrams, notes, citations

5
PUTTING-IN-PLACE
positioning the literature
↓
Making sense of the previous steps
Recognise juxtapositions, overlappings, recurring themes, research methodologies, etc.
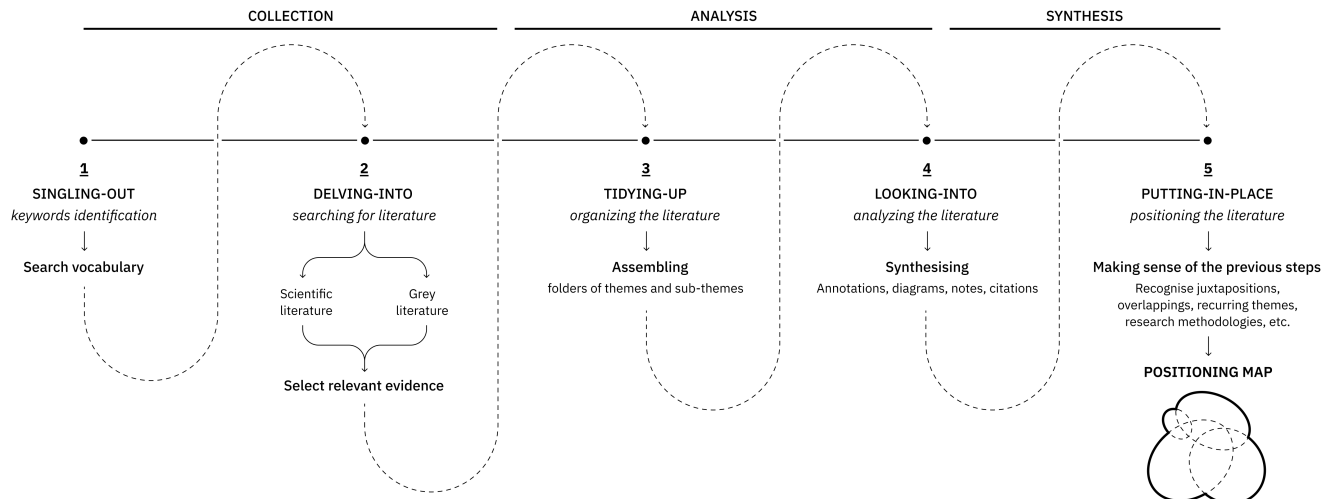↓
POSITIONING MAP

Figure 3 – Process of positioning the research (Aversa, 2022).

by Cooper and Hedges (1993), for this research, the process was further divided into five sub-stages (see Figure 3), named after the objectives identified for each of them:

1) Singling out
2) Delving into
3) Tidying up
4) Looking into
5) Putting in place.

The outcome is a "*positioning map*" (figure 4) showing the existing themes, questions, and methodological assumptions and uncovering the gap in such an ecosystem: a potential blank aperture encouraging new explorations and alternative readings—a void for the research to blossom.

1) *Singling out.* The first step was to develop a search vocabulary of the relevant keywords to locate potentially appropriate evidence. The act of *singling out* is based on the objective expressed in the research question, plus prior knowledge on the topic.
2) *Delving into.* The search vocabulary identified in the previous step is used to begin searching for literature. The search strategy plays a crucial role: how to outline the query? Which keywords to combine? Which operators to include in the query string? Among the available pool of results, it is fundamental to select potentially relevant literature, dismissing what does not address the issue.
3) *Tiding up.* The relevant literature is assembled in folders organised by themes and sub-themes. The themes are defined after a careful analysis of abstracts and indexed keywords. Reference management tools may facilitate this process.
4) *Looking into.* The effort required for this step is the most intensive of the entire process. It involves analysing each component of the collection, annotating it, discarding it, or

exploring it in detail, and synthesising concepts and connections between the fields involved through diagrams and visualisations.
5) *Putting in place*. The last cumbersome endeavour is to make sense of previous actions.

The encompassing aim is to recognise juxtapositions between different disciplines, overlappings, recurring themes, related research methodologies, and the complexity of the scientific discourse in such a way as to map the extent and relationships, following an approach similar to the cartography of controversies (Latour, 2007).

Mapping the void. The positioning map is organised around *main*- and *sub*- areas that define the disciplinary fields involved.
Design, media studies, and social sciences are the broadest fields with the most significant number of sources. Each of these areas addresses more specific sub-areas circumscribed to the purposes of the research. For instance, within the design field, the research focuses on information design, which is a sub-area of communication design. Moreover, these macro and micro areas are organised around *relevant concepts* that are not exclusive to a single discipline but rather addressed from different perspectives, so it can be that some fields overlap.
All the *relevant concepts* are further divided into clusters according to whether they are *terminologies*, *theoretical approaches*, or *methodologies*. Clustering, juxtaposing, merging and confronting such concepts allowed for reasoning about the gap, deducing applicable theories, outlining interconnections, and spotting viable pathways.

The *terminology* cluster is further divided into three micro-groups:
1) Authors who deal with information disorders on social media platforms. This cluster is

solely positioned within the media studies field and comprises concepts such as "*junk news*" (Venturini, 2019; Rogers & Niederer., 2020), "*virality*" (Nahon & Hemsley, 2013), "*participatory propaganda*" (Wanless & Berk, 2018), "*mass-self-communication*" (Castells, 2009), "*conspiracy theories*" (De Zeeuw et Al., 2020), etc.

2) Authors who elaborate on the definition of unreliable information visualisations. From this cluster emerges a dense heterogeneity in the definitions conceived and the lack of a common vocabulary. Some examples may be "*counter visualisations*" (Lee et Al., 2021), "*misleading visualisations*" (Tufte, 1983.

Cairo, 2015), "*crisis visualisations*" (Zhang, 2021), "*visualisation mirages*" (McNutt, 2020), "*vernacular visualisations*" (Snyder, 2018).

3) Authors that focus on the rhetorical power of visualisation. This cluster touches on different disciplinary fields that approach information visualisations as "*rhetorical instruments*" (Campbell & Offenhuber, 2019), providing "*a single translation of reality*" (Kosminsky & Seeler, 2019).

The *theoretical approaches* cluster comprises those approaches dealing with the politics and ethics of representation in terms of transparency of processes and
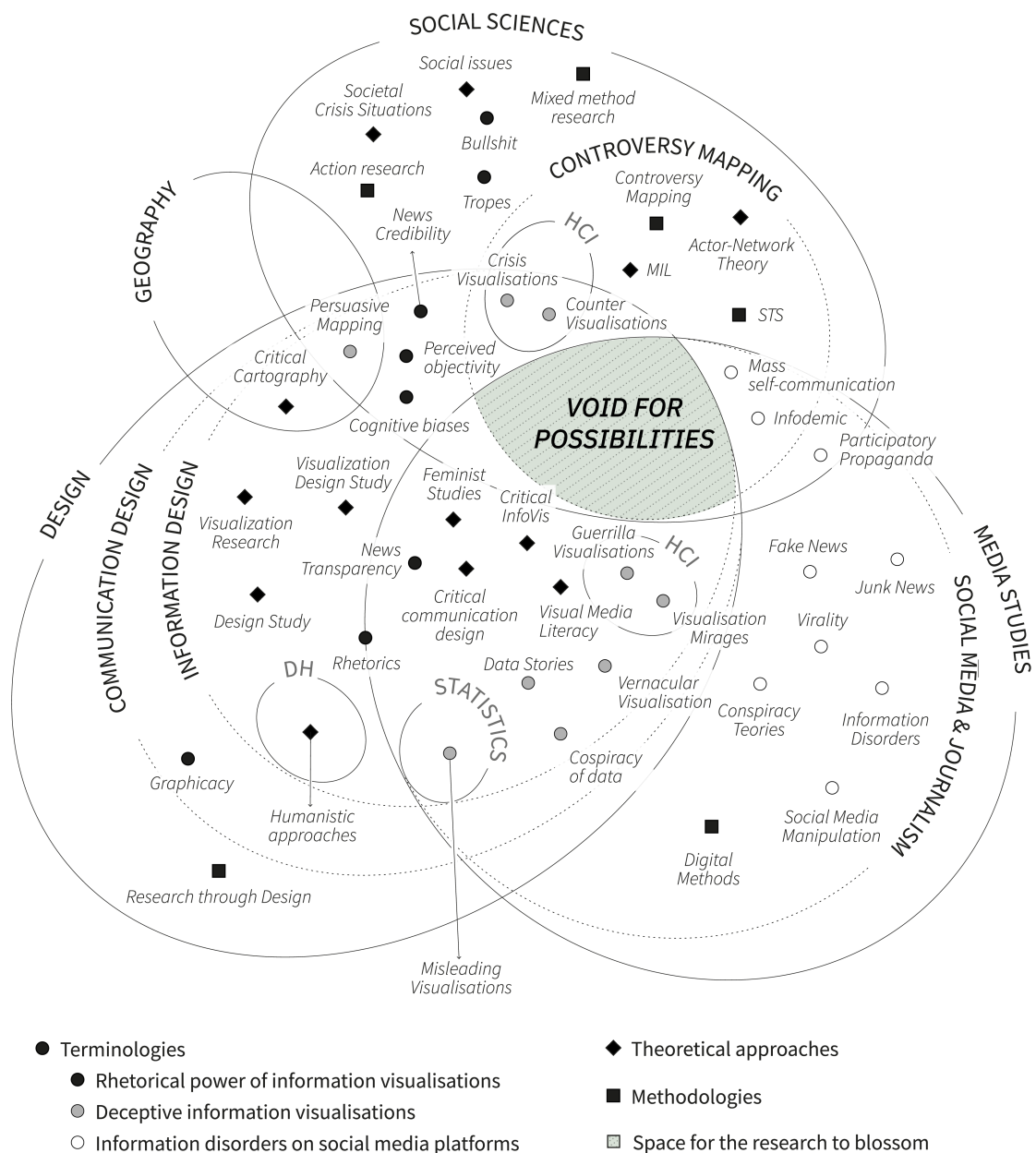

Figure 4 – Positioning map with relevant concepts, disciplinary fields, and the research gap (Aversa, 2022).

intentions. Some examples are "*critical InfoVis*" (Dörk et Al., 2013), "*Feminist Studies*" (D'ignazio et Al., 2020), Critical Cartography (Crampton et Al., 2015), and "*Design Study*" (Meyer & Dykes, 2019). The cluster also includes those authors researching and advocating for various kinds of literacies (e.g. visual, information, media).

The last cluster maps the relevant *methodologies* for the research. For instance, *Action Research*, in the guise of *Research through Design*, directs the entire research towards a designerly inquiry with the aim of producing an artefact that promotes societal change. The latter, combined with the "*case study approach*" (Law, 2015) of *Science, Technology and Society* (STS) and "*digital methods*" (Rogers, 2013)

In this ecosystem, the gap is positioned in the middle, at the intersection of the three main fields, suggesting new strategies in combining such heterogeneous knowledge in ways that can address the social impacts of *visualisation-supported* information disorders.

DISCUSSION

The following paragraphs discuss the literature identified in the positioning map that elaborates on: 1) the rhetorical power of information visualisation; 2) the effects of deception; 3) the issues arising from the circulation of information disorders on social media platforms; and 4) the need for critical approaches for information design circulating on social media.

The rhetorical power of information visualisation.
Even though the paper focuses on more recent times, the visual encoding of information is an "*age-old practice*" (Rendgen et Al., 2019) that stems from the necessity of translating complex information into graphical forms that "*facilitate understanding*" (Kirk, 2019) and allow for "*reasoning about quantitative information*" (Tufte, 1983).
The act of translation necessitates different degrees of abstraction and simplification (Kennedy et Al., 2016); thus, the narrative power of information visualisation has always been evident over the centuries.
Cartographic visualisations clarify this idea: a map is the result of a simplification process of projecting the uneven, spherical surface of the world on a two-dimensional plane. In fact, "*to avoid hiding critical information in a fog of detail, the map must offer a selective, incomplete view of reality*" (Monmonier, 1996).
Simplification and abstraction trigger specific narrative experiences, which may orient and direct the readers towards particular directions. Ergo, information visualisations work within the narrative frames of their designers and disseminators.
"*Les Triomphe des armées françaises*" (see figure 5) is an interesting example along these lines: the visualisation celebrates the victory of France in the war

of the first coalition. The cartographic element, in this case, is juxtaposed with illustrations that reinforce the propagandistic message embedded in the visualisation. The rhetorical power of information visualisation has been recognised and well exploited over the centuries, from the "*Golden Age of Statistical Visualisations*" (Friendly, 2008) to the more recent "*Second Golden Age of Data Design*" (Kostelnick, 2019) of the 21st century. In fact, over the last decade, the use of information visualisations has grown significantly (Bohman, 2015), shaping our perception and understanding of society. The outbreak of COVID-19 contributed to this trend: information visualisations became pivotal in online communication (Kasumba et Al., 2022) to make sense of the complexity and evolution of the pandemic. Research centres, data scientists, information designers, journalists, governments, as well as non-experts and social media users (Bowe et Al., 2020) became active actors in producing and disseminating such content. This heterogeneity of actors raised challenges regarding reliability and accuracy in the myriad of materials produced.

Figure 5 - Le Triomphe des armées françaises. Antoine Maxime Monsaldy, 1797.

From informing to misleading. Visualisations like words are powerful "*rhetorical tools*" (Hullman & Diakopoulos, 2011): they can be crafted to "*distort or lie*" (Cairo, 2015. Jones, 2018) and thus, they can mislead (Bergstrom et Al., 2020).
Like every narrative product, they convey the beliefs and perspectives of the social group of their creators (Pandey et Al., 2015). Similarly, how a visualisation is consumed depends on the literacies and assumptions of the final viewers.
In fact, viewing is influenced by gender, nationality, language ability, education, and age (Kennedy et Al., 2016) and by the discourses around data, society, and culture (Hill et Al., 2016). Social conditions affect how readers engage with culture (Barthes, 1978).
Therefore, visualisations cannot be considered impartial facts about the world and here lies the risk of underestimating their influence on society.
Whether there is a conscious intention to mislead or involuntary errors in shaping the charts and decoding

the underlying information, the resulting effect of deception may lead to unethical or irresponsible practices and outcomes.

On information disorders and social media platforms.

The concept of deception is linked to information disorders. The large-scale disruption of the public sphere due to *information disorders* proliferating on social media platforms, recognised as one of the most significant governance challenges, is causing widespread concern worldwide (Marwick et Al., 2017). In this respect, social media play a crucial role: they mediate access to information and facilitate content virality to such an extent that ordinary -and malicious-users can reach as many readers as established news agencies (Allcott et Al., 2017).

Compared to previous media technologies, the structure of social media platforms is utterly different. The way content circulates is democratic to such an extent that "*an individual user with no track record or reputation can in some cases reach as many readers as Fox News, CNN, or the New York Times.*" (Allcott et Al., 2017). The consequences on society can be manifold: from distorting people's ability to make sense of the world around them to undermining democratic processes and individuals' security.

Alongside, algorithms produce what Gillespie calls "*calculate publics*" (Gillespie, 2014) by transforming "*a discrete set of users into an audience"* (ibid). This may explain why information disorders find such ecosystems so fertile.

A good case study to explore for further elaboration on the topic is COVID-19. For instance, many incidents of public health concerns occurred out of information disorders circulating online during the pandemic. In some cases, the distorted perception of risk resulted in higher vaccine hesitancy and weaker adherence to mask-wearing protocols, as well as in the adoption of non-scientifically accepted treatments such as lemon and salt gargles and bleach injections (World Health Organisation, 2020a).

Seeing shall not entail believing. Critical approaches in information design.

This positioning paper aims to outline new possibilities in supporting critical approaches to information visualisation, starting from the assumption that *seeing should not be believing.*

To be critically engaged means nurturing the act of asking new pensive questions that challenge current conventions and assumptions and help to detect and disclose invisible and unspoken biases. Thinking critically is about using the knowledge generated from the "*new questions*" to reflect on "*what matters most*" (Hooks, 2010).

Starting from a kind of critical approach assuming that visualisations are always "*situated*" (Haraway, 1988) and depend strongly on several changing factors, the "new possibilities" enabled by this research lean

towards the design of effective literacy strategies aimed at mitigating and balancing the side effect of visualisation-supported information disorder. In particular, the systematisation of prior knowledge drawing from the aforementioned heterogeneous disciplinary fields can contribute to those initiatives supporting various literacies in the fields of media and information.

FUTURE WORK

The dense plethora of knowledge that emerged from the literature review calls for a "*fracture line*" (Foucault, 1969), which can lead to the unveiling of alternative dimensions. Stemming from this approach, the research aims at mitigating the social impacts of "*visualisation disorders*" through literacy initiatives addressed to those actors active in producing information visualisation (e. g., designers, and data journalists).

Therefore, future work will lean towards designing new tools and strategies which can enrich existing initiatives for individuals, democracy, and society in the field of Media and Information Literacy (MIL).

To be more specific, future efforts will focus on a threefold path: a) systematise and label prior knowledge to unify language; b) enrich the systematisation with the aspects of circulation, intentionality and caused harm of information visualisation on social media; c) make the systematisation applicable to support new strategies for literacy.

REFERENCES

Allcott, H. and Gentzkow, M. (2017) 'Social Media and Fake News in the 2016 Election', *Journal of Economic Perspectives*, 31(2), pp. 211–236. Available at: https://doi.org/10.1257/jep.31.2.211.

Atherton, R. (2021) '"Missing/Unspecified": Demographic Data Visualization During the COVID-19 Pandemic', *Journal of Business and Technical Communication*, 35(1), pp. 80–87. Available at: https://doi.org/10.1177/1050651920957982.

Hans, J.S., Barthes, R. and Heath, S. (1978) 'Image-Music-Text', *The Journal of Aesthetics and Art Criticism*, 37(2), p. 235. Available at: https://doi.org/10.2307/429854.

Bergstrom, C.T. and West, J.D. (2021) *Calling bullshit: the art of scepticism in a data-driven world*. New York: Random House.

Blevins, J.L. *et al.* (2021) 'Shouting Into the Wind: Medical Science versus "B.S." in the Twitter Maelstrom of Politics and Misinformation About Hydroxychloroquine', *Social Media + Society*, 7(2), p. 205630512110249. Available at:

https://doi.org/10.1177/20563051211024977.

Boehnert, J. (2016) 'Data Visualisation Does Political Things', in. *Design Research Society Conference 2016*. Available at: https://doi.org/10.21606/drs.2016.387.

Bohman, S. (2015) 'Data Visualization: An Untapped Potential for Political Participation and Civic Engagement', in A. Kő and E. Francesconi (eds) *Electronic Government and the Information Systems Perspective*. Cham: Springer International Publishing (Lecture Notes in Computer Science), pp. 302–315. Available at: https://doi.org/10.1007/978-3-319-22389-6_22.

Bowe, E., Simmons, E. and Mattern, S. (2020) 'Learning from lines: Critical COVID data visualizations and the quarantine quotidian', *Big Data & Society*, 7(2), p. 205395172093923. Available at: https://doi.org/10.1177/2053951720939236.

Cairo, A. (2015) 'Graphics Lies, Misleading Visuals', in D. Bihanic (ed.) *New Challenges for Data Design*. London: Springer London, pp. 103–116. Available at: https://doi.org/10.1007/978-1-4471-6596-5_5.

Castells, M. (2009) '*Communication power'*. Oxford ; New York: Oxford University Press.

Ceron, W., de-Lima-Santos, M.-F. and Quiles, M.G. (2021) 'Fake news agenda in the era of COVID-19: Identifying trends through fact-checking content', *Online Social Networks and Media*, 21, p. 100116. Available at: https://doi.org/10.1016/j.osnem.2020.100116.

Cinelli, M., Quattrociocchi W., Galeazzi, A., Valensise, C., M., Brugnoli, E., Ana Lucia Schmidt, A., L., Zola, P., Zollo, F., Scala, A. (2020) 'The COVID-19 social media infodemic', *Scientific Reports*, 10(1), p. 16598. Available at: https://doi.org/10.1038/s41598-020-73510-5.

Cooper, H., & Hedges, L. V. (1994) *The handbook of research synthesis.* Russell Sage Foundation.

Correll, M. (2019) 'Ethical Dimensions of Visualization Research', in *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. CHI '19: CHI Conference on Human Factors in Computing Systems, Glasgow Scotland Uk: ACM, pp. 1–13. Available at: https://doi.org/10.1145/3290605.3300418.

Creswell, J.W. and Tashakkori, A. (2007) 'Editorial: Differing Perspectives on Mixed Methods Research', *Journal of Mixed Methods Research*, 1(4), pp. 303–308. Available at: https://doi.org/10.1177/1558689807306132.

Crampton, J. W., & Krygier, J. (2015) An Introduction to Critical Cartography. *ACME: An International Journal for Critical Geographies*, 4(1), 11–33. Retrieved from https://acme-journal.org/index.php/acme/article/view/723

De Zeeuw, D. *et al.* (2020) 'Tracing normiefication', *First Monday* [Preprint]. Available at: https://doi.org/10.5210/fm.v25i11.10643.

D'Ignazio, C. and Klein, L.F. (2020) *Data feminism*. Cambridge, Massachusetts: The MIT Press (Strong ideas series).

Doan, S. (2021) 'Misrepresenting COVID-19: Lying With Charts During the Second Golden Age of Data Design', *Journal of Business and Technical Communication*, 35(1), pp. 73–79. Available at: https://doi.org/10.1177/1050651920958392.

Dörk, M., Feng, P., Collins, C., & Carpendale, S. (2013) 'Critical InfoVis: exploring the politics of visualization', in *CHI '13 Extended Abstracts on Human Factors in Computing Systems on - CHI EA '13. CHI '13 Extended Abstracts on Human Factors in Computing Systems*, Paris, France: ACM Press, p. 2189. Available at: https://doi.org/10.1145/2468356.2468739.

Drucker, J. (2011) *Data Visualization's Breakthrough Moment in the COVID-19 Crisis*. Medium. Available at: https://medium.com/nightingale/data-visualizations-breakthrough-moment-in-the-covid-19-crisis-ce46627c7db5 (Accessed: December 2022)

Engebretsen, M. and Kennedy, H. (eds) (2020) '23. What is at stake in data visualization? A feminist critique of the rhetorical power of data visualizations in the media', in *Data Visualization in Society*. Amsterdam University Press, pp. 391–406. Available at: https://doi.org/10.1515/9789048543137-027.

Foucault, M. (1969). 'Archaeology of Knowledge'. Routledge. https://doi.org/10.4324/9780203604168

Friendly, M. (2008) 'The Golden Age of Statistical Graphics', *Statistical Science*, 23(4). Available at: https://doi.org/10.1214/08-STS268.

Gillespie, T., Boczkowski, P.J. and Foot, K.A. (eds)

(2014) *Media Technologies: Essays on Communication, Materiality, and Society*. The MIT Press. Available at: https://doi.org/10.7551/mitpress/9780262525374.001.0001.

Gray, C. and Malins, J. (2004) *Visualizing research: a guide to the research process in art and design*. Aldershot, Hants, England ; Burlington, VT: Ashgate.

Haraway, D. (1988) 'Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective', *Feminist Studies*, 14(3), p. 575. Available at: https://doi.org/10.2307/3178066.

Hart, C. (1998) *Doing a literature review: releasing the social science research imagination*. London: Sage Publications.

Helmond, A. (2015) 'The Platformization of the Web: Making Web Data Platform Ready', *Social Media + Society*, 1(2), p. 205630511560308. Available at: https://doi.org/10.1177/2056305115603080.

Hill, R.L., Kennedy, H. and Gerrard, Y. (2016) 'Visualizing Junk: Big Data Visualizations and the Need for Feminist Data Studies', *Journal of Communication Inquiry*, 40(4), pp. 331–350. Available at: https://doi.org/10.1177/0196859916666041.

hooks, bell (2010) *Teaching critical thinking: practical wisdom*. New York: Routledge.

Hullman, J. and Diakopoulos, N. (2011) 'Visualization Rhetoric: Framing Effects in Narrative Visualization', *IEEE Transactions on Visualization and Computer Graphics*, 17(12), pp. 2231–2240. Available at: https://doi.org/10.1109/TVCG.2011.255.

Jones, G.E. (2018) *How to lie with charts: fourth edition*. 4th edition. Santa Monica, CA: LaPuerta Books and Media.

Kasumba, R., Pandey, S., Patel, V., Wolfson, M., Ottley, A. (2022) *User Engagement with COVID-19 Visualizations on Twitter*. preprint. Open Science Framework. Available at: https://doi.org/10.31219/osf.io/es6ua.

Kennedy, H., Hill, R. L., Aiello, G., Allen W., (2016) 'The work that visualisation conventions do', *Information, Communication & Society*, 19(6), pp. 715–735. Available at: https://doi.org/10.1080/1369118X.2016.1153126.

Kirk, A. (2019) *Data visualisation: a handbook for data driven design*. 2nd edition. Los Angeles London New Delhi Singapore Washington DC Melbourne: SAGE.

Kostelnick, C. (2019) *Humanizing visual design: the rhetoric of human forms in practical communication*. New York London: Routledge (Routledge studies in technical communication, rhetoric, and culture).

Latour, B. (2007) *Reassembling the social: an introduction to Actor-Network-Theory*. Oxford: Oxford Univ. Press.

Law J. (2015). '*STS as Method*'. Harvard, pp. 1.-24.

Lee, C., Yang, T., Inchoco, G. D., Jones, G. M., & Satyanarayan, A. (2021) 'Viral Visualizations: How Coronavirus Skeptics Use Orthodox Data Practices to Promote Unorthodox Science Online', in *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems. CHI '21: CHI Conference on Human Factors in Computing Systems*, Yokohama Japan: ACM, pp. 1–18. Available at: https://doi.org/10.1145/3411764.3445211.

Marres, N. S. (2005) *No issue, no public: democratic deficits after the displacement of politics*. Thesis, fully internal, Universiteit van Amsterdam, pp. 90-93. Ipskamp Printpartners.

Marwick, A., & Lewis, R. (2017) *Media Manipulation and Disinformation Online*. Data & Society Research Institute.

McNutt, A., Kindlmann, G., Correll, M. (2020) 'Surfacing Visualization Mirages', *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, pp. 1–16. Available at: https://doi.org/10.1145/3313831.3376420.

Meyer, M. and Dykes, J. (2019) 'Criteria for Rigor in Visualization Design Study', *IEEE Transactions on Visualization and Computer Graphics*, pp. 1–1. Available at: https://doi.org/10.1109/TVCG.2019.2934539.

Monmonier, M.S. (1996) *How to lie with maps*. 2nd ed. Chicago: University of Chicago Press.

Muehlenhaus, I. (2013) 'The design and composition of persuasive maps', *Cartography and Geographic Information Science*, 40(5), pp. 401–414. Available at: https://doi.org/10.1080/15230406.2013.783450.

Muratovski, G. (2016) *Research for designers: a guide to methods and practice*. London: Sage Publications.

Nahon, K. & Hemsley, J. (2013) '*Going viral'*. Cambridge, England: Polity Press.

Nærland, T.U. and Engebretsen, M. (2021) 'Towards a critical understanding of data visualisation in democracy: a deliberative systems approach', *Information, Communication & Society*, pp. 1–19. Available at: https://doi.org/10.1080/1369118X.2021.1968922.

Offenhuber, D. (2010) 'Visual anecdote', in *ACM SIGGRAPH 2010 Art Gallery on - SIGGRAPH '10. ACM SIGGRAPH 2010 Art Gallery*, Los Angeles, California: ACM Press, p. 367. Available at: https://doi.org/10.1145/1836786.1836792.

Pachauri, R.K., Mayer, L. and Intergovernmental Panel on Climate Change (eds) (2015) *Climate change 2014: synthesis report*. Geneva, Switzerland: Intergovernmental Panel on Climate Change.

Pandey, A.V., Rall, K., Satterthwaite, M. L., Nov, O., Bertini E. (2015) 'How Deceptive are Deceptive Visualizations? An Empirical Analysis of Common Distortion Techniques', in Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems. Seoul Republic of Korea: ACM, pp. 1469–1478. Available at: https://doi.org/10.1145/2702123.2702608.

Pavliuc, A.M. and Dykes, J. (2020) 'Designing Effective Network Visualization Representations of Disinformation Operations - Improving DisInfoVis', *EuroVis 2020 - Posters*, p. 3 pages. Available at: https://doi.org/10.2312/EURP.20201118.

Van Prooijen, J.-W. and Douglas, K.M. (2017) 'Conspiracy theories as part of history: The role of societal crisis situations', *Memory Studies*, 10(3), pp. 323–333. Available at: https://doi.org/10.1177/1750698017701615.

Rendgen, S. *et al.* (2012) '*Information graphics'*. Köln: Taschen.

Rogers, R. (2013) *Digital methods*. London: Mit Press.

Rogers, R. & Niederer, S. (2020) '*The politics of social media manipulation'*. Amsterdam: Amsterdam University Press.

Segel, E. and Heer, J. (2010) 'Narrative Visualization:

Telling Stories with Data', *IEEE Transactions on Visualization and Computer Graphics*, 16(6), pp. 1139–1148. Available at: https://doi.org/10.1109/TVCG.2010.179.

Shelton, T. (2020) 'A post-truth pandemic?', *Big Data & Society*, 7(2), p. 205395172096561. Available at: https://doi.org/10.1177/2053951720965612.

Snyder, J. (2017) 'Vernacular Visualization Practices in a Citizen Science Project', in *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing. CSCW '17: Computer Supported Cooperative Work and Social Computing*, Portland Oregon USA: ACM, pp. 2097–2111. Available at: https://doi.org/10.1145/2998181.2998239.

Tagliabue, F., Galassi, L. and Mariani, P. (2020) 'The "Pandemic" of Disinformation in COVID-19', *SN Comprehensive Clinical Medicine*, 2(9), pp. 1287–1289. Available at: https://doi.org/10.1007/s42399-020-00439-1.

Tufte, E. R. (1983). *The visual display of quantitative information*. Graphics Press.

Venturini, T. (2010) 'Diving in magma: how to explore controversies with actor-network theory', *Public Understanding of Science*, 19(3), pp. 258–273. Available at: https://doi.org/10.1177/0963662509102694.

Venturini, T. (2019) From Fake to Junk News, the Data Politics of Online Virality. In Bigo, D., Isin, E., & E. Ruppert (Eds.), Data Politics: Worlds, Subjects, Rights. London: Routledge

Wanless, A. & Berk, M. (2022) '8 Participatory Propaganda: The Engagement of Audiences in the Spread of Persuasive Communications', in D. Herbert and S. Fisher-Høyrem (eds) *Social Media and Social Order*. De Gruyter Open, pp. 111–137. Available at: https://doi.org/10.2478/9788366675612-009.

Wardle, C. & Derakhshan, H. (2019). *Understanding Information Disorders.* First draft's essential guide to. First Draft.

Wolfson, E. (2020). *COVID-19 looks a lot closer to the seasonal flu than to previous coronavirus outbreaks.* Available at: https://time.com/5798168/corona virus-mortality-rate/ (Accessed: December 2022)

World Health Organization (2020a). *Coronavirus*

disease (COVID-19) advice for the public: Mythbusters. Available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/myth-busters (Accessed: December 2022)

World Health Organization. (2020b) *Novel Coronavirus(2019-nCoV). Situation Report–13*. https://www.who.int/docs/default-source/coronavi-%20ruse/situation-reports/20200202-sitrep-13-ncov-v3.pdf (Accessed: December 2022)

Zhang, Y. *et al.* (2021) 'Mapping the Landscape of COVID-19 Crisis Visualizations', in *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems. CHI '21: CHI Conference on Human Factors in Computing Systems*, Yokohama Japan: ACM, pp. 1–23. Available at: https://doi.org/10.1145/3411764.3445381.