Sensemaking and Learning during the Covid-19 Pandemic: a Complex Adaptive Systems Perspective on Policy Decision-making

Federica Angeli[1]

Chair in Management
The York Management School
University of York
Freboys Lane, YO10 5GD
Heslington, York
Phone: +44 19 04326443
E-mail: federica.angeli@york.ac.uk

Andrea Montefusco

Professor of Practice in Leadership
LUISS Business School
Rome, Italy
E-mail: amontefusco@luiss.it

[1] Corresponding author

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Abstract: Governments worldwide are under enormous pressure to effectively and promptly address the increasingly complex crisis presented by the Covid-19 pandemic. To understand the difficulties inherent to policymakers' sensemaking and learning processes during this unprecedented challenge, this article develops a perspective rooted in complexity theory. We highlight that, just as complex adaptive systems, societies affected by the pandemic and by the subsequent containment policies present non-linear and unpredictable outcomes, which highly depend on the social systems' initial states and on the behavioral rules governing the actions and interactions of the agents composing the systems. This analysis underlines that any decision-making process in a highly complex crisis such as the Covid-19 pandemic is inherently inaccurate and short-sighted. Far, however, from suggesting a policy paralysis, with this perspective we highlight the need to embed complexity thinking in policy decision-making and we present a roadmap for learning based on a flexible and adaptive approach, locally optimal solutions, and the need for international cooperation and transparent dissemination of data.

Keywords: Covid-19 pandemic; Complex adaptive systems; Learning and Sensemaking processes; Policy decision-making.

As of today, few would disagree that the Sars-CoV-2 virus and the resulting Covid-19 acute respiratory syndrome are causing an unprecedented, highly complex crisis. Governments and international organizations have been called to quickly react to a huge public health emergency by devising effective and proportionate policy actions. This effort, however, requires a fast-tracked sensemaking process that is cognitively prohibitive. While some observers have argued the possibility to 'learn lessons' from the early experience of countries like China, South Korea and Italy (Pisano et al. 2020), we caution towards the possibility – and the potential dangers – to expect and demand a clear learning trajectory and to therefore blame and shame those who seem to fall behind the curve – be it national governments or international bodies such as the World Health Organization. We do so by analyzing the current situation through the lens of 'complex adaptive systems', which provides a theoretical standpoint that is particularly apt to understand the behavior of social systems affected by Covid-19. Among many defining characteristics, complex adaptive systems are *non-linear*, they are *highly dependent on their initial conditions*, and are constituted by a *high number of interactions* among agents whose behavioral rules (schemata) are in continuous evolution (Morel and Ramanujam 1999, e.g. Zimmerman 2010).

The Covid-19 pandemic as a non-linear phenomenon

Pandemics should be considered in the broad class of non-linear phenomena, in that one small system perturbance may trigger disproportionate, exponential systemic reactions. This is visible in the case of an epidemic contagion, where one infected individual may pass the disease to an *R0* number of individuals which ranges from 1.5 to even 6.49 in the case of Covid-19 where no social distancing is applied (Liu et al. 2020), starting a geometric progression of rapidly increasing infected cases. Humans' cognitive models are not likely to represent non-linear

phenomena efficiently, as these events progress far quicker than usual decision-making processes. Unfamiliarity with non-linearity causes two dreadful effects: it hinders learning and distorts *mental rehearsal,* which is a well-explored and fundamental step to set up robust *intuitive* decision-making processes (Kahneman 2011, Klein 2004). While intuition is necessary when the previous experience is insufficient to deal with current events, when stakes are high it is critical to mentally rehearse the possible effects of decisions. Unfortunately, because humans are unused to non-linear thinking, such mental expectations are likely to follow a linear pattern: a small variation in causes are expected to trigger a small variation of outcomes and vice-versa, while disproportionate, unexpected, longer-term effects are disregarded. In the case of Covid-19, school closures have been enforced in most countries, even though the children's role in the community spread of the virus is still debated (Bayham and Fenichel 2020, Mandavili 2020, Viner et al. 2020). In some settings, disadvantages of school closures might disproportionally override the benefits, especially in contexts where schools constitute a safe harbor from domestic abuse towards disadvantaged children (The Economist 2020). Moreover, the longer-term effects of schools' closures on children's mental health are now under increased scrutiny (Lee 2020). Variations in the sensemaking processes of such disparate outcomes have produced policy decisions on school reopening that differ widely across countries. While Italy will reopen only in September, the Netherlands has reverted to the pre-Covid19 school service already on June 8.

Thinking linearly in non-linear situations also hinders learning, especially where non-linear causality involves feedback loops, delays and dynamic behaviors (Sterman 2002). When X causes Y we also need to consider the influence of Y on X, hence the adaptive responses of systems and individuals based on 'performance feedback'. This learning mechanism relies on three pillars: first, the availability of adequate and reliable performance information, that can

inform action; second, the identification of realistic performance aspirations, that are negotiated among relevant stakeholders; third, the availability of a solid conceptual and empirical link between input and systemic output (Gavetti et al. 2012). As for the latter, decision-makers try to explain outputs through inputs, without considering internal effects and the system's history, stored in state variables (Sterman 2002). This problem may lead to seemingly well-working systems going out of control because the controller can neither influence nor measure relevant variables: they are simply out of the learning feedback loop. In the case of Covid-19, it is increasingly clear that some organizations, institutions and countries have been non-transparent with respect to state variables, such as the number of infected cases in nursing homes (The Guardian 2020) or the death toll (BBC 2020). However, keeping information outside the feedback loops hinders their efficacy, so it is important to favor transparency, cooperation and guarantee psychologically safe environments, even in international relationships (Edmondson 2018).

The case of Covid-19 highlights also the learning difficulties related to unreliable measures of the output itself - failures and successes. The Covid-19 mortality rate, as the ratio between casualties and number of registered infections, is still dramatically different across countries, reflecting the variation in the testing capacity of healthcare systems. Italy and the UK – where mortality rates are now around 14% - have carried out a limited and strictly necessary number of Covid-19 swabs (mostly around hospitalized patients) while Germany has chosen for a more widespread testing policy, which allowed for a more realistic estimate of the number of infected individuals and for more effective isolation (Münchau 2020). Unsurprisingly, Germany has a registered mortality rate of 4.6%, also explainable with the 29.2 ICU beds every 100.000 inhabitants against 12.5 of Italy and 6.6 of the UK (Bittner 2020). Doubts about the nominator of

the mortality ratio also have arisen, due to cross-country inconsistencies around the attribution of casualties to Covid-19, for example, related to variations of post-mortem testing policies and to accountings of non-hospital Covid-19 deaths in, for instance, nursing homes (Booth 2020). When comparing the 2020 mortality to the average of previous years, again the picture changes, and highlights a much higher Covid-19 mortality toll than the one registered in almost every country (Burn-Murdoch and Giles 2020).

Third, what can – and should – policymakers reasonably aspire to? The Covid-19 poses the problem of longitudinal interdependent goals, where saving lives in the short-term might sacrifice lives, social order and well-being in the longer-term due to the risk of an unparalleled economic recession and the mental health consequences of prolonged lockdown and social distancing measures. Lockdown measures have also important ethical ramifications, as they restrict individual freedom, strengthen surveillance (Harari 2020), increase gender-based and domestic violence, and generally raise concerns of human rights infringement (United Nations 2020). Moreover, despite the substantial 17% fall in CO2 emissions due to populations' confinement and travel restrictions, the epidemic runs the risk of dangerously diverting attention from climate change goals, and without structural change, the temporary environmental benefits are unlikely to last (Hook and Wisniewska, Le Quéré et al. 2020).

Social systems' dependency on initial conditions

Governments' Covid-19 containment measures should be considered as complex interventions in complex social systems, which are highly dependent on their initial conditions.

The complex interventions theory rests on a realist idea of causality that considers the interaction between an expected mechanism with its context, to produce a specific outcome (Pawson 2006, Sanderson 2000). Likewise, the evolution of a pandemic like Covid-19 and of the subsequent containment policies cannot be considered outside their national context, intended as political circumstances as well as socio-economic and socio-cultural makeup of the affected population.

Complex adaptive systems are composed of a high number of interactions between agents whose behavioral rules (schemata) evolve over time. Measures such as social distancing, face-masks and hand-washing are conceived to bend social and individual behavior in a way that hinders the contagion. Achieving behavioral change is however a complex endeavor, highly moderated by cultural habits. Adaptation and variations of individual behaviors are likely to be easier in countries those which have already learned from the experience of MERS and SARS, like South Korea and Honk-Kong. The past experience raised the awareness of today's risks, while making behavioral schemata available both for act and adapt (Rerup and Feldman 2011). At the same time, interventions that have succeeded at containing the virus dissemination in China – an authoritarian regime – can hardly be replicable in a context such as the EU and Italy. Likewise, measures implemented in South Korea, the Netherlands or Sweden, that largely rely on individual, voluntary responsibility rather than on sanctions, might not be applicable in contexts where the average citizen is less confident in governmental actions, and thus less compliant. Only mechanisms that are aligned, socially acceptable, and attuned with the local context will lead to the desired outcome. In this light, the widespread calls to 'learning' from the experience of other countries should be considered with extreme caution, and carefully adjusted by the multiple factors – and their interactions - that jointly create the idiosyncratic local context.

Initial conditions refer also to the amount of knowledge available to decision-makers at the point of decision. When Italy discovered the first patient, the risk of an outbreak of Covid-19 in Europe was still low, and no cognitive attention or mental alertness – by medical personnel, healthcare providers and the public – was cast on recognizing the symptoms of a Covid-19 infection. As a result, in the span of 48 hours, 160 new cases were discovered in Lombardy and it became apparent that the deadly infection has spread unrecognized for some time. In the wake of what happened to Italy, countries with a similar socio-cultural and socio-economic background but far later in the infection curve and with more time to make sense and rationalize managed to block the epidemic by imposing lockdown measures even before the first death – such as Greece (Smith 2020).

Conclusions

With the analysis above, we highlight the compelling need for a complexity-oriented theoretical lens to understand the challenges of policy decision-making in a complex crisis such as the Covid-19 pandemic. Far from suggesting a policy paralysis, we underline that it is of utmost importance to pursue learning, by continuously analyzing newly available data, and adjusting available solutions. However, we draw attention to four main caveats, in evaluating current policies and in designing future ones as the pandemic progresses.

First, policy measures only offer a local optimum and are valid only at a specific point in time, while new emerging data – or unexpected consequences - might disconfirm the initial assumptions and impair the validity of earlier decisions. Second, decision-makers should be aware of non-linear processes and on non-measurable system states, and hence be ready for the possibility of unpredictable and disproportionate consequences of their actions. Future policies

should explicitly address these two points, by understanding the importance – and enhancing the acceptance - of a flexible, highly adaptive, decision-making approach. *Fast and frugal* decision-making – that does not aspire at incorporating all available information – might be acceptable in fast-changing, complex situations, to avoid the paralyzing effect of pursuing fully informed choices that are cognitively too burdensome (Dosi et al. 2020, Gigerenzer and Brighton 2009). Third, because of the systems' high dependence on their initial conditions and idiosyncratic behavioral rules of agents, applying interventions that have been successful elsewhere will almost certainly trigger different outcomes, so measures should always be corrected for the characteristic of the local system. The complexity perspective emphasizes the need for interventions that are tailor-made around local experiences, and on how individuals and societies have historically been able to cope and ethically accept the restrictions. At the same time, policymakers should be aware that local optimal solutions (regional or national) could collide with systemic aims and impair decision-making and conflict resolution at the higher decisional level (national or international). Fourth, because of the inherent decision-making complexity, a *blame-and-shame* mindset should be avoided, as it hinders transparency of outcomes and causes, and worsens the chances to understand the system and predicts its behavior. It is therefore compelling for national governments and international organizations to learn to behave systemically and cooperate, with a view to sharing information as transparently as possible, while strengthening the infrastructure to improve data gathering and processing. International collaboration and the development of shared protocols will be of paramount importance to achieve sustainable solutions, in this unprecedented global policy effort.

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