Rationalizing Inquiry Paths for Responsible Design in the Context of a Global Pandemic

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ABSTRACT

The systemic disruptions caused by the Covid-19 pandemic amplified the effects of some social inequalities and revealed positive environmental effects associated with slowing the economy. In order to explore the repercussions of contagion prevention and community engagement initiatives such as deploying face masks and visualizing Covid-19 statistics, we resorted to an ethical model of Design for Responsible innovation (DRI). This interactive model is useful for identifying, exploring, and describing analytical and generative paths of inquiry departing from, or arriving at, diverse matters of concern such as the impact of commodification and manufacturing in society and nature, the relativism of truth, the segregation of identities, and the reduction of agency. In this paper we argue that the human-centered perspective on design relies on a biased value system that either disfavors some social groups or disregards nonhuman living agencies, and we emphasize the analytical capacity of the model to chart and rationalize alternative inquiry paths. In consequence, future responsible design interventions would benefit from positioning life at center stage and embracing the relational and dependent nature of human beings from a posthuman perspective. To achieve this, research methods capable of handling human-nonhuman units of analysis and allowing the examination of systemic impact in complex systems are needed.

Keywords: data visualization, design research, ethics and values, face masks, responsible innovation.

INTRODUCTION

In the months after the first cases of SARS-CoV-2 were reported in Wuhan, China, two major objectives emerged to drive global and local pandemic responses: maintain infected population numbers below local healthcare provider capacity, and achieve safe and sustainable therapeutics and mechanisms for immunity. In the light of these challenges, we reflect on the impact and relevance of design actions for mobilizing opportunities to envision renewed futures.

As the virus continues to spread around the world, actors at all scales are responding to systemic impacts by taking design action. The World Health Organization (WHO) designed strategic preparedness and response plans on the basis of early findings from outbreaks in China, Iran, and Europe (World Health Organization, 2020). Governors have implemented experts' advice by designing ordinances that reduce the frequency of face-to-face interaction. Virologists and biologists are urgently designing rapid Covid-19 diagnosis techniques and mechanisms to train our immune systems to recognize and combat SARS-CoV-2 antigens. Epidemiologists design contagion models based on mobility restrictions and contact-tracing

to predict, contain, and monitor the virus's spread. Bioengineers collaborate with doctors to design new ventilators and other medical devices.In describing the cases above, we have highlighted design actions emerging as non-design disciplines and organizations devise solutions to the massive and multifaceted problems presented by the global Covid-19 pandemic. By contrast, in this paper we explore the impact and relevance of design actions emerging from design communities. Rather than describe cause-effect relations, our objective is to trace epistemological connections among design methods and the issues engaged by designed artifacts, overtly and covertly.

In this task, we resort to the Design for Responsible Innovation (DRI) model, a framework for critical engagement with the ethical stakes and impacts of design endeavors. As we have shown elsewhere, the DRI model is a pedagogical tool that helps scholars and educators engage with the opportunities and challenges of designing with consequences in mind (Salamanca, Briggs, Mercer, 2019)[1]. In our previous publication we discuss how the DRI model organizes ethical, epistemological and politico-philosophical concerns throughout a design research process. In the present paper we deploy the DRI model as a scaffold for describing and explaining—that is, rationalizing—inquiry paths concerning two ready-made global examples of design interventions: face masks, and visualizations of Covid-19 related data.

In this paper we introduce the methodological framework used in our analysis, demonstrate the use of the DRI model explore design inquiry paths for reviewing, critiquing, and building on existing designed artifacts. First we consider how face masks perform symbolic functions beyond the physiological control of infection. Then we describe and analyze visual accounts of correlations between structural social problems and abated economies, and discuss opportunities for design practitioners and scholars to address central "matters of concern." Finally, we comment on the relevance of the DRI model as an analytical tool for thinking critically and creatively about the consequences of design and offer some conclusions on the role of flat ontologies for designing responses in the current crisis.

1. METHODOLOGICAL FRAMEWORK

The Design for Responsible Innovation (DRI) model is an interactive network of interconnected concepts clustered by domains in order to structure the activity of design researchers and practitioners seeking to envision improved futures and reflect on their making. We regard design for responsible innovation as intentional action to design, reify, and maintain positive, equitable, and meaningful futures desired by sustainable networks of human and non-human actors (Salamanca, Briggs, Mercer, 2019). In the context of the DRI model, "responsible" refers to tracing analytical and generative connections among design methods, research approaches, ethical stakes, and impacts. DRI is concerned with objective, fair, nonpartisan and sustainable design actions, especially with regard to issues of contemporary debate such as environmental conservation, ethics, justice, equity, culture, and identity (Stilgoe, Owen, & Macnaghten, 2013).

The DRI model consists of four conceptual domains, which we refer to as "components," that allow users to associate design actions with ethical stakes and concomitant impacts with help from research traditions in the humanities and social sciences. Each component contains multiple domains of knowledge and/or practice, which we call "nodes." Directional connections between source-target pairs of nodes are called "links" (see Figure 1). To guide

the reader, in the sections below we italicize upon first mention those terms that name the DRI model's components and nodes.
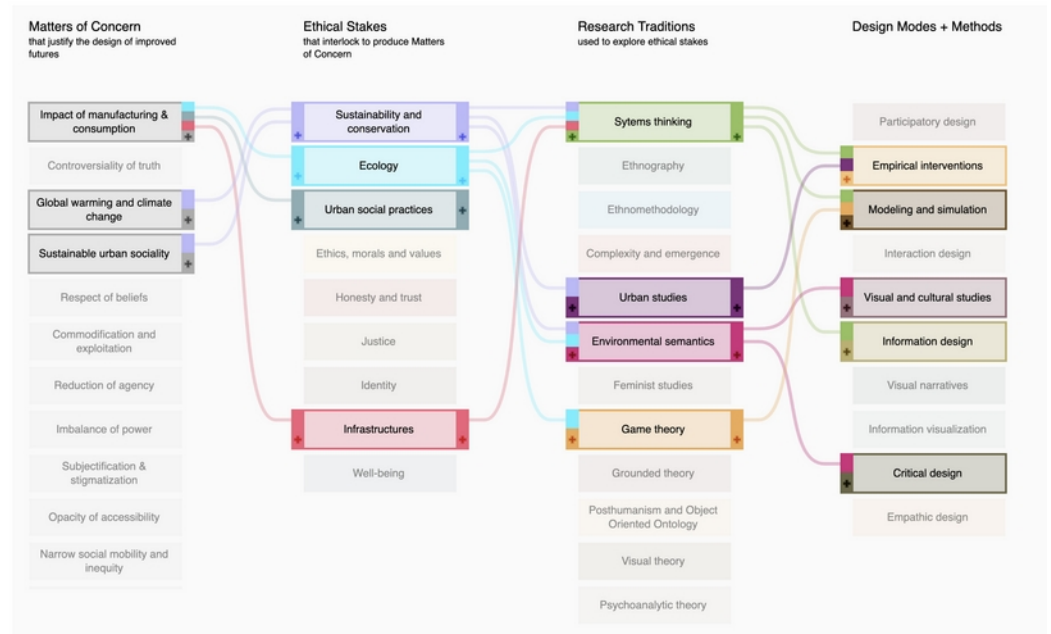

Figure 1. DRI model representing a research program on Sustainable and Regenerative Design.

The nodes in the leftmost component describe socio-environmental *Matters of Concern*. In so-naming this component we echo Latour's (2005) distinction between "matters of fact" and "matters of concern" in order to engage design's capacity for effecting change in both society and the environment. That is, rather than choose between advocating either for "design for social change" or "sustainable design," we avoid reproducing a false dichotomy[2]. The DRI model can be used for questions of both social and environmental significance, thereby allowing design researchers to develop research questions and methodological approaches concerning a heterogenous range of observable phenomena. The Matters of Concern component presents a menu of nodes that span this broad range of human and nonhuman activity. While comprehensive, this menu is not exhaustive: it is simply a place to start.

The rightmost component aggregates *Design Modes and Methods*. Whereas a traditional innovation approach would be likely to devise value-laden solutions by connecting one or more of the nodes from this component with a single issue in the leftmost component, our model compels the researcher to scrutinize the innovation proposition in the light of ethical stakes and select among research traditions accordingly. The nodes gathered in the *Ethical Stakes* component reflect foundational aspects of human, social, and environmental morality. The nodes gathered in the *Research Traditions* component present well-established research frameworks for observing and taking action as interventions are deployed. Again it should be noted that these components are comprehensive but not exhaustive.

The DRI model is not a static framework, but rather an interactive scaffold supporting networks of knowledge and practice domains. The definition of any node can be accessed by hovering over it. The nodes gathered in each component are not intended to be exhaustive; rather, the interface allows users to add new nodes to enable the analysis of issues not accommodated by the default configuration. Indeed, it is the very process of selecting nodes and/or conceptualizing new nodes that may sharpen the researcher's grasp of the ethical stakes and/or methodological nature of their work. As users make links between nodes in different components, they either associate or generalize concepts. *Convergencies* occur

when one or many links originating in source nodes coincide in a target node. *Divergencies* are observed when a single source node is linked to several target nodes.

The model allows users to explore multiple paths for design research in the course of building robust methodological frameworks. The model does not, in itself, constitute a design research method. Rather, it serves as a conceptual tool for rationalizing courses of design research for responsible innovation. As users of the model draw associations and generalizations among nodes, they problematize, theorize, or otherwise inform either the direction of their own design process or the impact of existing design interventions.

2. USING THE MODEL TO ANALYZE DESIGN INTERVENTIONS

In order to explore the impact and relevance of design in the context of the Covid-19 pandemic, we have selected two exemplary design cases that respond to the WHO's technical guidance topics "Infection Prevention and Risk Communication" and "Community Engagement." Specifically, we use the DRI model to examine the use of face masks and the appearance of pandemic-related data visualizations published in major United States (U.S.) newspapers.

2.1. Design Inquiry Perspectives on Face Masks

The face mask is an artifact whose many distinct varieties have been designed for specific purposes and contexts (Belting, 2017). Facial coverings have been used to mitigate the spread of disease for centuries (Strasser & Schlich, 2020). Mask wearing is emerging as a critical factor in mitigating the spread of disease in the current pandemic (Greenhalgh, 2020). However, current advice varies widely from region to region and within regions, preventing policy from being adopted at a systematic scale comparable to the speed and range with which the virus is spreading. Whereas citizens throughout South Korea are advised to carry two different kinds of face mask for use in different settings (Arin, 2020; Jeong, 2020), the U.S. has issued no national policy on mask use. Rather, policy is set at state and municipal levels and contested at every scale. Some governors have issued statewide mask orders while others have left it to local authorities to issue masks orders, and some have issued edicts that actively contravene municipal and county orders (Flynn & Iati, 2020). The piecemeal manner in which mask use has been indicated by U.S. authorities is complicated by the lack of specificity as to what type and the unpredictable availability of various types. This allows for a wide variety of individual choice, a point which dovetails with the fact that masks are worn not only to protect, but also to make a statement (Silver, 2020). In this dynamic situation, the possibilities for addressing this suddenly-ubiquitous artifact as an object of design research are myriad.

In order to discern the design dimensions of heterogenous artifacts, systems, and processes, it is helpful to conceive of design as a mode of solving problems where the solution has a communicative capacity (Briggs, 2020)[3]. The mask can be examined at this nexus of problem-solving and communication by using the DRI model to conceptualize design research questions that coordinate design methods, research traditions, ethical *stakes*, and social and environmental impact. In the following examples we use the DRI model to consider the face mask as an object for inquiry in terms of the truth of science, individual agency, and at-risk populations. In each case we show how the DRI model can assist in articulating research questions that describe, critique, and/or project.

Ideas about mask-wearing are tied to perspectives about the truth of science. People hold varying beliefs about what wearing a mask will accomplish. They may want to keep themselves safe, or they may believe it can help to keep others safe. If one believes the mask is meant to protect the wearer, the decision to wear it may be based on how much risk one perceives in the community, how much risk one is willing to bear, or the extent to which one believes the mask is effective at mitigating that risk. Such questions assume the wearer has not already been exposed to Covid-19. Conversely, if one believes the mask is meant to protect others, then the decision to wear it may be based on the perception of how much risk the community faces, understanding that people who do not have symptoms may have been exposed to the virus and be asymptomatic carriers, and the extent to which one feels invested in protecting others' health. All of these questions are affected by whether the wearer believes he or she may have already been exposed to Covid-19 or is experiencing symptoms.

In order to grasp the mask's epidemiological function, seemingly contradictory ideas must be held in concert: I don't feel sick. It is possible that I have been exposed to Covid-19. I could be an asymptomatic carrier. Wearing a mask protects others in the community from exposure to any virus I may be carrying. This will reduce the viral load at the community level. As a member of the community, I gain protection when others do the same.
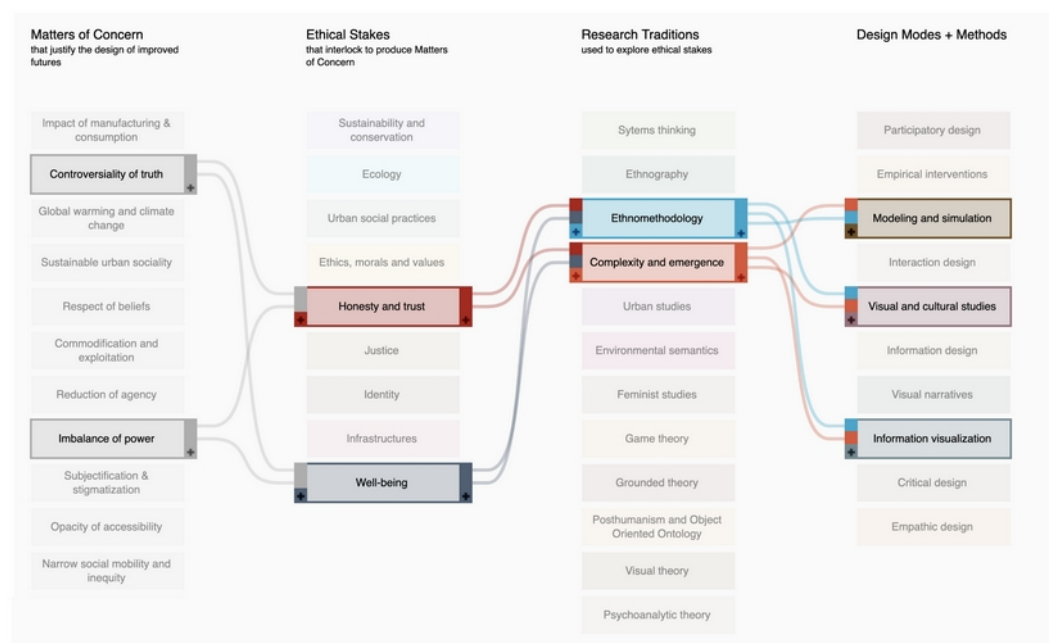

Figure 2. A design research path for generating questions about mask use in the context of debates over the truth of epidemiological science during the Covid-19 pandemic.

Figure 2 charts one possible research path for examining the impact of current debates over the truth of epidemiological science on mask-wearing during the Covid-19 pandemic. This example is not intended to represent the best or only way to investigate this topic but rather demonstrates the model's use-value for identifying and articulating design research questions. Here, *Controversiality of truth* and *Imbalance of power* have been selected in order to describe recent instances in which U.S. government officials have contradicted other state, and municipal public health officers on the necessity of mask-wearing. For example, the U.S. President has routinely appeared mask-less while standing beside colleagues at press briefings and campaign rallies even after coronavirus was shown to have been transmitted at such events, and a number of governors have refused to issue mask orders even in states

where infections are spiking. Such conflicting directives are both reflective and causative of controversy about the truth of the science on Covid-19's spread.

In order to consider the ethical stakes of this controversy we might select *Honesty and trust* and *Wellbeing*, nodes that together describe relative confidence in epidemiological data and discourse. In the *Research Traditions* component we can select *Complexity and emergence*. Emergence is a phenomenon wherein entities take on properties their parts do not possess individually, as for example when a population gains herd immunity or begins wearing face masks or otherwise changes its behavior at a significant scale. Emergent properties and behaviors occur when parts interact with other parts of a wider whole. They appear when discrete entities or agents interact in a manner that forms complex behaviors, as in the case of the patterns of disease observed in the science of epidemiology. In order to deploy complexity and emergence as a design research methodology, as opposed to as an epidemiological research methodology, we have also selected *Ethnomethodology*, the examination of social behaviors and practices that produce and maintain the social order.

The next step is to activate these research traditions by selecting design methods. For example, *Information visualization,* or the process of presenting data in a visual manner that affords intuitive access to meaning, can lead the researcher to ask questions such as, how are specific existing data visualizations affecting public understanding of the epidemiological significance of mask-wearing? Or, how might new data visualizations affect this understanding? In order to answer these questions, we might also deploy *Modeling and simulation* and *Visual and cultural studies*. Combining all three design modes/methods can allow the researcher to quickly conceptualize a host of specific, viable, and probing questions. For example, in what ways do patterns in mask-wearing constitute legible, real-time information visualizations on local cultural understandings of epidemiological science? Or, is there a tipping point where observed mask-wearing in the community influences individual behavior?

Ideas about mask-wearing are tied to perspectives about individual agency. Given that our objective is to demonstrate the DRI model's capacity for generating research questions and agendas, and that answering such questions would fall beyond the scope of our paper, let us turn to another major factor in mask-wearing. Whereas it has long been common in Asian societies for citizens who are not feeling well to wear a mask in order to protect others from illness, mask-wearing has been much less common in Western societies (Chan, 2020). Prior to the emergence of Covid-19 there was little to no discussion of using masks to protect individuals outside of healthcare settings. Consequently, recent public health directives to wear masks are frequently misunderstood to be aimed at protecting the wearer (Tufekci, Howard, & Greenhalgh, 2020). This has raised debates about what kind of mask one should wear in order to accomplish this task.

Mask directives have caused a significant change in public behavior, but there is a correspondingly significant debate about what wearing a mask means. For example, some read mask-wearing as an indication of awareness of public health policy and epidemiological function or solidarity with fellow citizens, while others have framed mask-wearing as a purposeful assault on individual freedom, and the U.S. President has argued that citizens who wear masks are doing so for the express purpose of demonstrating political opposition to his administration (Bender, 2020; North, 2020).

Figure 3 presents a design research approach to the topic of mask-wearing that focuses on questions about individual agency in decisions about whether to wear a mask. We can frame the Matter of Concern as Reduction of agency and define the ethical stakes as *Urban social practices and Identity.* If we use the same research traditions selected above but now draw design methods from *Visual and cultural studies* and *Critical design,* we can formulate design research questions such as, how does the mask function as a communicative device? Or, where/when/how does mask-wearing provoke anxiety about individual agency or identity? Or, to what extent do individuals' selection of masks support their sense of individual identity? Or, how might we design masks that communicate differently, or more effectively, about identity?
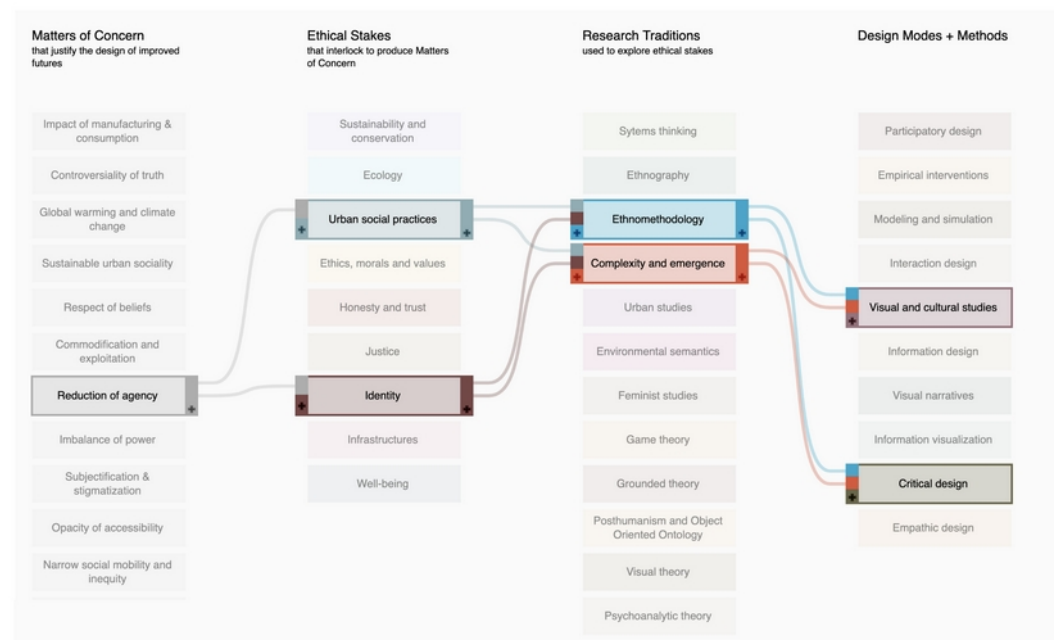

Figure 3. A design research path for generating questions about mask use in the context of debates about individual agency.

Debates about mask-wearing have tangible consequences for at-risk populations. At the time of this writing, the U.S. is seeing the largest outbreak of Covid-19 on the globe (CRC, 2020). It has also become clear that the virus takes its largest toll on populations already at risk. For example, Covid-19 risk factors include preexisting medical conditions such as heart disease and diabetes, which in the U.S. are disproportionately represented in communities of color. These risk factors are correlated with low income, crowded living conditions, food insecurity, and homelessness and lack of access to clean water, education, and health care. Communities of color in the U.S. are also subject to greater practical barriers to social distancing and face disproportionate rates of joblessness and threat of job loss, lack of geographic mobility, and dependence on public transportation. For all of these reasons, these communities face greater risk of contracting and transmitting Covid-19 than the larger population.
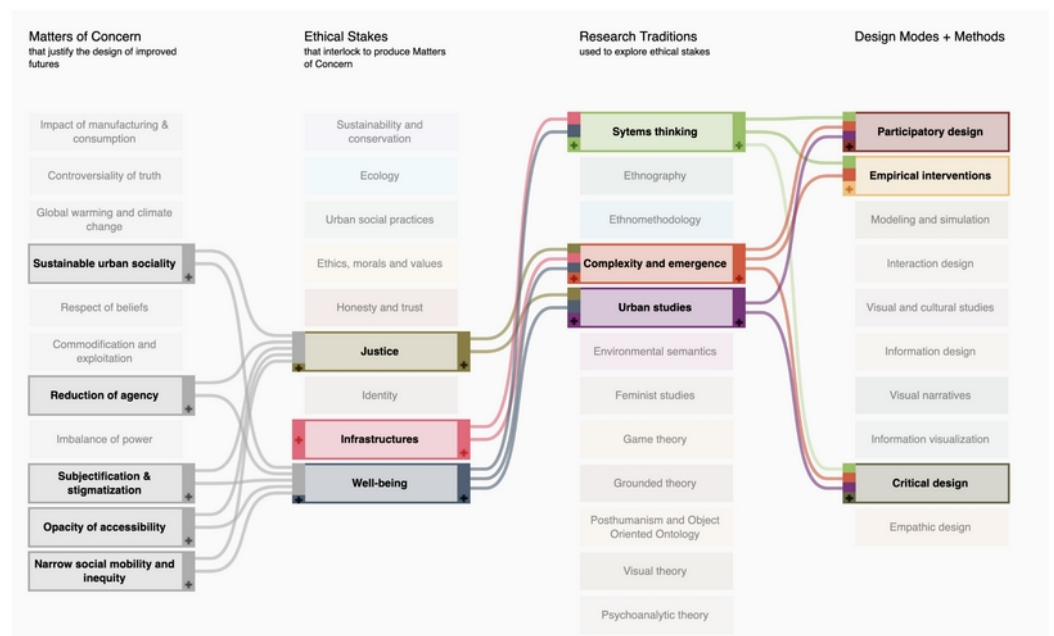
Figure 4. A design research path for generating questions about the intersection of Covid-19 with mass protests against police brutality.

Given this correlation between race, class, and epidemiological risk, it is likely no coincidence that mass demonstrations against police brutality and systemic racism have emerged in the U.S. (and spread throughout the world) during the global pandemic. Figure 4 shows how a design researcher might develop questions such as, how do inconsistent policies on mask use correlate to patterns of disease transmission and social protest? Or, how do discourses about individual agency intersect with the structures of institutional racism in the context of decisions about mask use on the part of racially or economically representative cohorts?
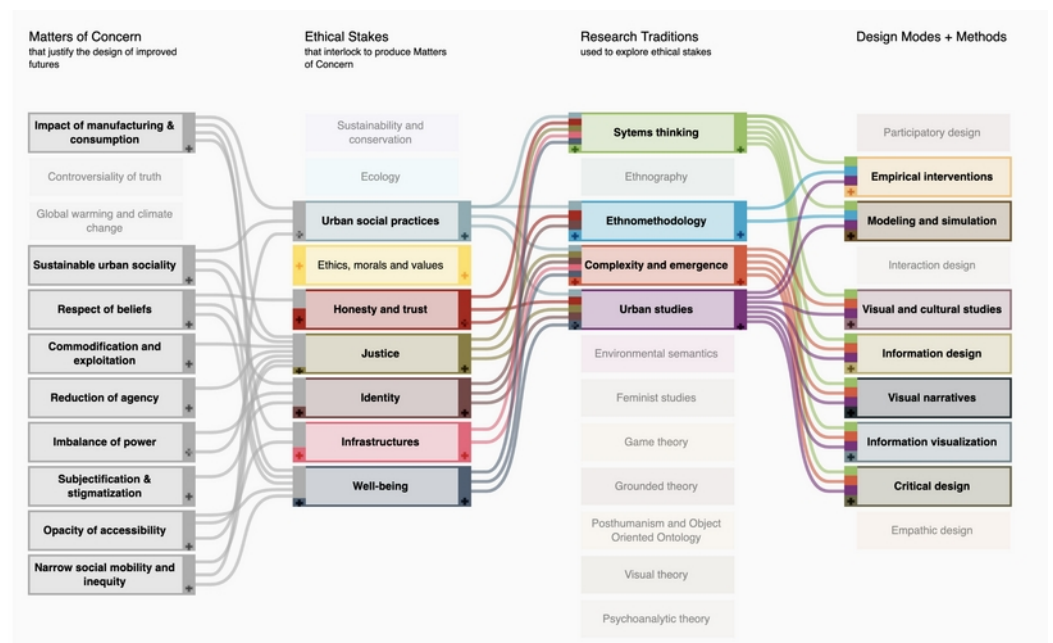

Figure 5. As the model grapples with structural racism the paths become too complex to read.

In order to gain traction on the complex and dynamic phenomenon wherein which a global change of public awareness and political will has emerged in the context of the pandemic, Figure 5 grapples with structural racism in a more granular way. But as the relevant nodes in the leftmost component are selected, the model becomes so complex as to become difficult to use, thereby defeating its purpose.
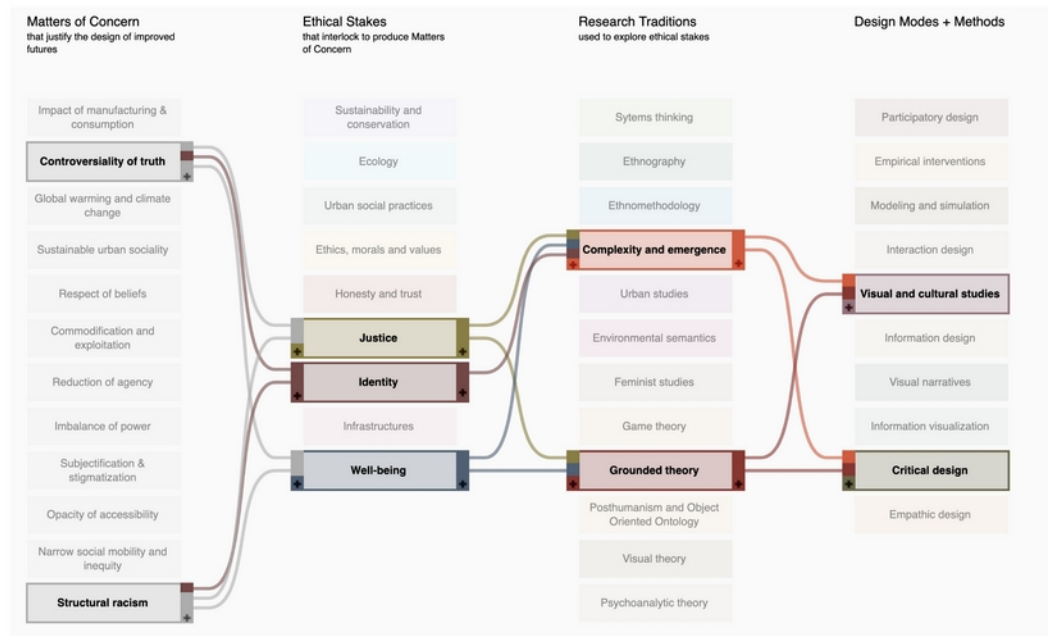
Figure 6. Adding a new node simplifies the model and restores legibility and usability.

Figure 6 shows that adding a new node, structural racism, simplifies the model's left side considerably[4]. We can continue to clarify the model by selecting only Justice and *Well-being* as the ethical stakes, with the understanding that the other nodes selected in Figure 5 are implicit within them. If we are equally selective with research traditions and design modes and methods, we arrive at an economical diagram for a design research agenda in which the questions raised with Figure 4 can serve as sub-questions within a broader inquiry into the way current debates over the truth of epidemiological science have intersected with questions of individual agency to produce broad popular awareness of widespread structural racism in the U.S. and around the world.

2.2. Design Inquiry Perspectives on Dynamic Visualizations and Interactive Maps

It is exceptional in democracies to see national and regional authorities implement mass home confinement, restriction of geographic mobility, and prohibitions on public gatherings. Communication designers have made significant contributions in explaining to citizens the rationales motivating these decisions and how to proceed under the new scenarios, as well as in highlighting inequalities exacerbated by the same decisions. In this section, we use the DRI model to devise spaces of inquiry around pandemic-related data visualizations published in mass media outlets in the U.S.

In order to explain how social distancing and stay-at-home decisions can relieve the contagion rate, maintain low numbers of infected cases, and prevent an overflow of patients in intensive care units (ICUs), scientists resorted to time-series charts where the horizontal axis represented days and the vertical axis the number of cases. Regardless of the country, the number of cases drew a rising curve. Public health specialists coined the expression "flatten the curve," meaning that if the number of critical cases grew beyond ICUs' capacity, medical doctors might be forced to deny some patients the right treatment or forward them to other facilities. Although informative of a potential crisis, this type of visual explanation does not account for the actual impact of lockdown and social distancing, because it only shows what has happened to date; it does not show what a downward trend would look like.

Using an agent-based model simulation (ABM), Stevens (2020) illustrated the relevance of individual decisions and collective compliance with top-down governmental decisions (Figure 7). This dynamic chart presents the curve behavior of a hypothetical virus in four different scenarios: in normal life, in forced quarantine, in moderate social distancing, and in extensive social distancing including closed public gatherings.

Figure 8 shows how the DRI model can be used to analyze Stevens's ABM simulation. The design modes and methods Stevens used include *Modeling and simulation*, *Visual narratives*, and *Information visualization*. Although highly simplified, Stevens' visualization emerges from the interactions of individual agents with scripted rules. That is, each time the simulation is ran it yields a somewhat different output. This dynamic visualization is non-deterministic, a property of research traditions that account for *Complexity and emergence* in social systems (Sawyer, 2005).
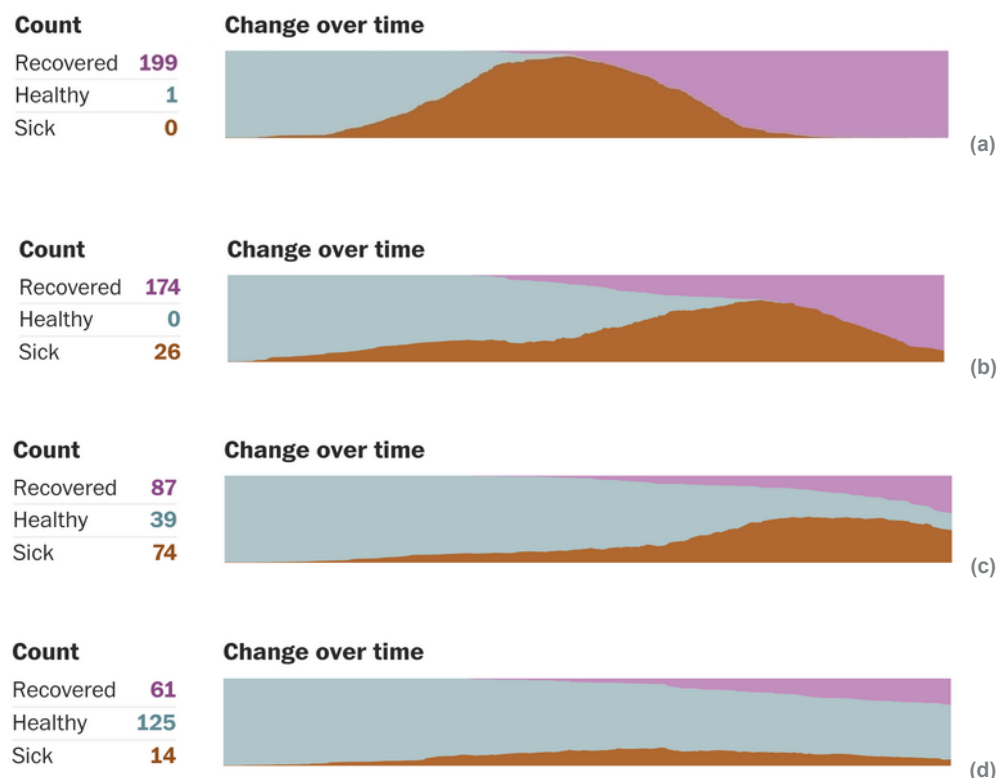

Count

Recovered	**199**
Healthy	**1**
Sick	**0**

Change over time (a)

Count

Recovered	**174**
Healthy	**0**
Sick	**26**

Change over time (b)

Count

Recovered	**87**
Healthy	**39**
Sick	**74**

Change over time (c)

Count

Recovered	**61**
Healthy	**125**
Sick	**14**

Change over time (d)

Figure 7. Excerpts of visualization "Why Outbreaks Like Coronavirus Spread Exponentially, and How to 'Flatten the Curve'." These agent-based simulations show the effects of (a) simple contagion, (b) forced quarantine, (c) social distancing, (b) extensive distancing on a population of 200 individuals (Stevens, The Washington Post, 2020).

ABMs of restricted mobility and social distance policies yield scenarios that challenge the accepted moral norms associated with some of the nodes in the ethical stakes component such as regular *Urban social practices* (Wolfram, 2020) and medical *Infrastructure* accessibility (Kerr et al., 2020). For example, quarantines and social distancing constitute forms of *Agency reduction* in the eyes of conservatives who regard such measures as unconstitutional, or *Disrespectful of peoples' beliefs* in the case of banned religious gatherings.

With regard to Matters of Concern, the decision to shut down public places like restaurants, cinemas, schools and stores demonstrates a two-faceted case of *Impact of manufacturing and consumption*. On the one hand, such actions have the negative economic impact of slowing the trade of non-essential goods or diverting people to alternative modalities of access to essential services such as education. On the other hand, there are positive environmental impacts associated with reducing non-essential manufacturing or limiting motorized

mobility. Qualifying the morality of these interrelated impacts as positive or negative requires engaging with the ethical stakes of flattening the curve and reflecting on the attendant matters of concern.

As to the ethical stakes of *Infrastructure management*, other complementary ABMs that account for some demographics and real transmission networks (Currie et al., 2020) bring to the fore the moral issues associated with how protective and medical equipment, pharmaceutical products, and tests are allocated. At the city or state level, rural areas or less-dense neighborhoods might receive them later than their urban or more populous counterparts. At the global level, nations funding Covid-19 research might receive them before less-invested countries.

Figure 8. DRI model analyzing Stevens' visualization "Why Outbreaks Like Coronavirus Spread Exponentially, and How to 'Flatten the Curve'."

ABMs are partial abstractions of reality. Therefore, the *Opacity of accessibility* to *Infrastructures* associated with structural racial disparities cannot be derived from general models with homogeneous populations. For this reason, Williams and Blanco (2020) resort to an interactive choropleth map in order to visualize the higher statistical risk of contracting Covid-19 or suffering severe illness by communities of color in the U.S. (Figure 9 shows the Washington D.C. area). Risk is determined for each census tract by correlating three data sets: the level of access to healthcare, average rates of chronic health issues, and the vulnerability index as reported by the U.S. Centers for Disease Control and Prevention (CDC). Color and saturation represent the risk of severe illness in each tract. Filtering tracts by race and ethnicity reveals a positive correlation between the size of the minority population and the risk of Covid-19 severity.
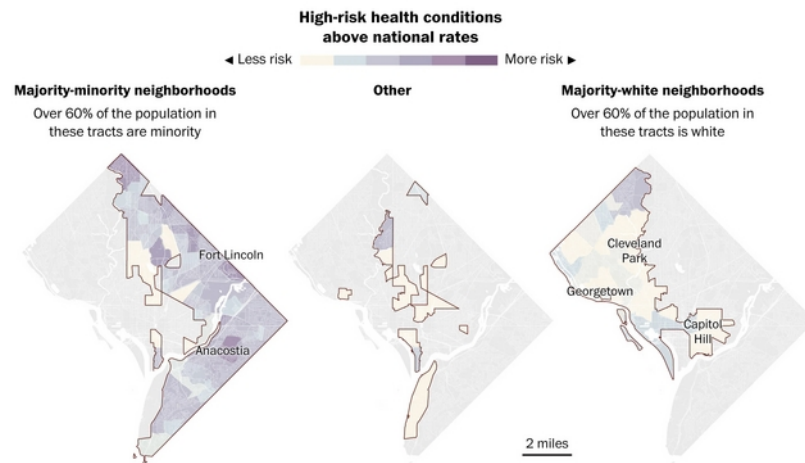
Figure 9. Maps contrast the health risk rates between neighboods with minority (left) and white(right) population in the District of Columbia, U.S. Neighborhoods with other population are shown in the middle (Williams and Blanco, The Washington Post, 2020).

Oppel et al. created a choropleth map of the racial inequity associated with Covid-19 incidence that extends William and Blanco's work (Figure 10). It portrays disaggregated U.S. Covid-19 cases by White, Black, Latino, Asian, and Native American ethnic groups based on data of 55% of U.S. population (Oppel, Gebeloff, Lai, Wright, & Smith, 2020). Using a series of six sequential color scales, each hue represents the ethnic group with the highest number of cases, while saturation indicates the size of infected population. Areas with higher saturation reflect Black and Latino cases, except in the case of Native Americans in Arizona. Oppel et al. conclude that Latinos and African-Americans are three times as likely to become infected as their white neighbors. Some structural factors could explain these statistics: Black and Latino workers are more likely to hold jobs that require their physical presence, such as in factories, manufacturing facilities or infrastructures that supply essential services, and more likely to commute by public transportation. In some counties, the density of residents per housing unit is higher for Latino populations, a factor which hinders social distancing.
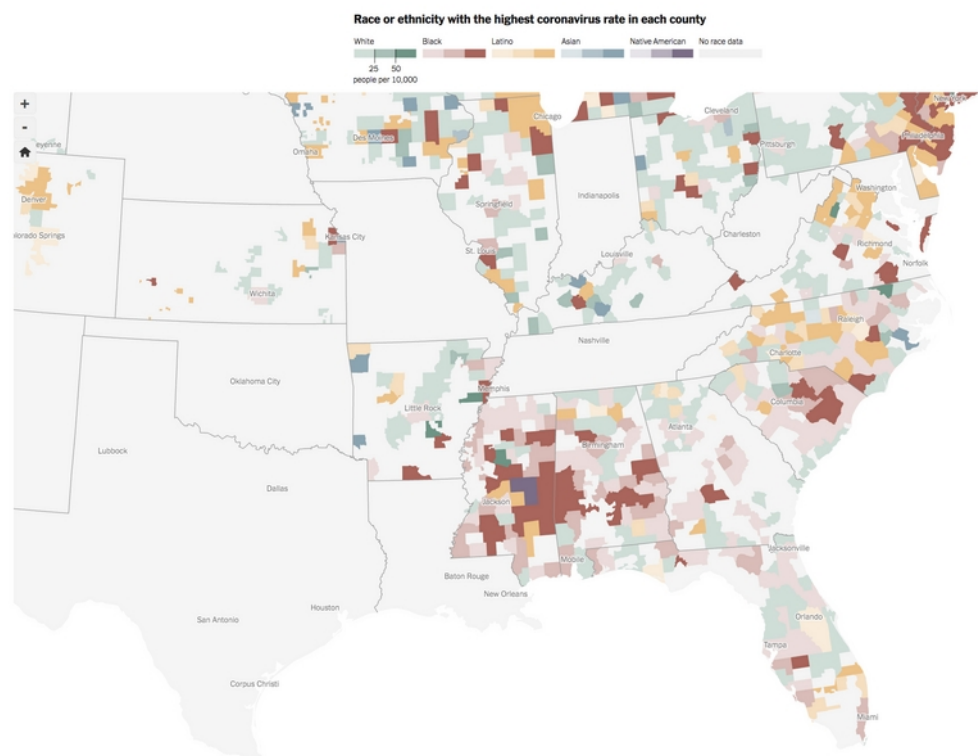
Figure 10. Section of interactive choropleth of U.S. south-east counties by race or ethnicity with highest coronavirus rate. The color represents race or ethnicity and the saturation denotes up to 75 cases per 10000 people as of July 2020 (Oppel et al., The New York Times, 2020).

Using the DRI model to describe and analyze the interactive maps in Figures 9 and 10 yields a network of inquiry lines about the consequences of flatten-the-curve policies for minority populations (Figure 11). In Williams and Blanco's and Oppel at al.'s work, we identify *Information visualization* and I*nteraction design* as their primary modes of design action. These actions are informed by findings and data derived from research traditions in *Urban studies* and quantitative *Statistical* analysis. The researchers' interest in health inequities associated with race and ethnicity can be described as issues of *Wellbeing, Identity* and *Urban social practices* in the ethical stakes component. Williams and Blanco's emphasis on patterns of chronic disease among minorities connects with *Structural racism* and anticipates the consequences of the virus due to *Opacity of accessibility* to health insurance and medical treatments in those communities. Oppel et al.'s work extends the network by exposing the concomitant relation between the higher vulnerability of Black and Latinos and the *Commodification and exploitation* of labor. These ethnic groups account for the majority of in-person labor needed to maintain *urban social practices* such as the distribution of food or the expansion of real state.
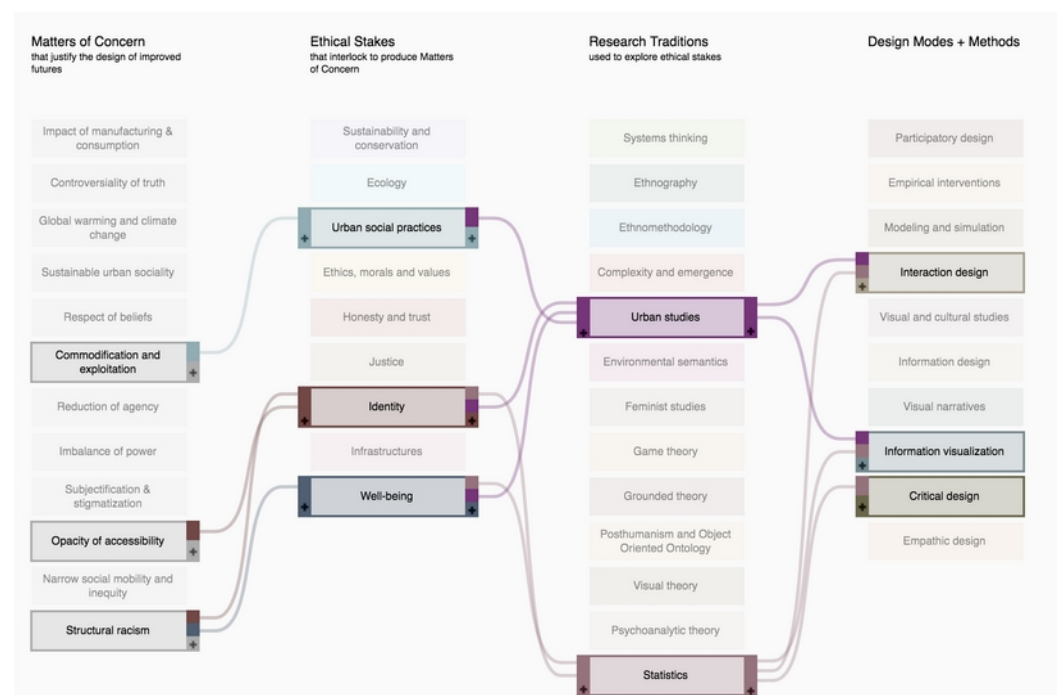

Figure 11. Inquiry lines depicting concerns on race and ethnicity portrayed in interactive visualizations published in two major U.S. newspapers.

3. DISCUSSION AND CONCLUSION

The DRI networks outlined in sections 2.1 and 2.2 critique the value systems underpinning the fabrication and maintenance of design interventions. Such value systems predate pandemic-related ordinances that restrict agency or exacerbate social imbalances. Consequently, many current design interventions reinforce, intendedly or unintendedly, existing inequities in public realms like health policy and urban planning. To be clear, designers should not be held solely responsible for these ethical issues; after all, design experts and nonexperts conjointly make the artificial world (Manzini, 2015). But designers have an opportunity to think more critically about how those value systems give shape to design interventions, and the public can benefit from understanding the extent to which design creations echo moral biases.

Not in vain does the DRI model qualify matters of concern as *reasons that justify the design of improved futures.* This ethos differs from the Western logic of faster, better, cheaper, stronger. Instead, it invites designers and citizens to care for diverse, undermined, neglected and vulnerable agencies, including non-human agencies. Improved futures are possible when design solutions account for the relational nature of life and embrace all the agencies that constitute us as humans. To that end, there is a need for an alternative worldview to Protagoras' *homo-mensura dictum* (man is the measure of all things) with which to structure next-decade design research programs. Life-centered (Escobar, 2018), posthuman (Forlano, 2017), and relational perspectives (Gergen, 2009) on design, together with research methods capable of embracing ethics, complexities, participation and hybridizations, are foundational to the project of designing fair, heterogenous and sustainable futures.

In this paper we illustrated how the proposed DRI model serves to critically examine face masks and data visualizations published in mass media. As many other solutions implemented by public policy specialists around the globe, these ones carry controversies about the truth of science, the trade-offs of self vs. community health risks, and the neglected inequalities due to race and ethnicity that, in the case of the United States, render communities of color more vulnerable than others. The pandemic brought to light spaces of design inquiry on the consequences of political and public health decisions of conveniently loading designed artifacts with populist symbolism, and on the critical role of communication designers in translating the complexity of diverse and collective action into graspable visual messages for individual decision making. Future visions of good design should embrace sustainable, fair, and desirable ways of coexisting.

The analysis presented herein shows the critical and provocative potential of the DRI model. It allows design researchers to formulate descriptive, analytical or generative design research questions and invites them to explore methodological approaches to address them. Using it foments knowledge of and expertise with research traditions and directs attention to ethical stakes in a manner that young scholars and design practitioners will find useful to their academic training. As stated earlier, the given array of nodes is not exhaustive; rather, design researchers can add nodes to better represent their research programs or, as illustrated herein by the introduction of the *Structural racism* node, encapsulate node associations in generalizable concepts.

ENDNOTES

[1] The DRI model reflects the interests of faculty and students of the MFA program in Design for Responsible Innovation in the School of Art and Design at the University of Illinois at Urbana-Champaign.

[2] Just as twentieth-century particle physicists displaced the concept of an imperceptible physical "ether" in which entities were disposed, so Latour argues that the notion of "society" as context, an extra variable that complicates or confounds activity taking place in other "nonsocial" domains set within it—another kind of "ether"—should be discarded.

[3] This definition enables design researchers to investigate artifacts and systems that arise in domains that transcend existing design disciplines design boundaries or domains of human activity not conventionally understood to be design-based.

[4] "Racism is not only prejudice against a certain race due to the color of a person's skin, as it states in your dictionary. It is...prejudice combined with social and institutional power. It is a system of advantage based on skin color." –Kennedy Mitchum in her email asking Merriam-Webster Dictionary to update its definition of "racism" (Hauser, 2020).

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