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Prospecting a systemic design space for pandemic response

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ABSTRACT

Design literature describes an expansion of design activity towards systemic relations, the so-called fourth order of design. In this order, design is supposed to deal with sociotechnical controversies — public deliberations over technical and social relations that include multiple actors with conflicting interests. This research looks at the sociotechnical controversy around COVID-19 design responses to map the extent of said expansion through a hybrid method. The controversial design space mapping method included web pages on design projects aimed at the pandemic as a source of problems, solutions, actors, and interests. The results reveal that actors overlooked systemic relations, possibly due to neoliberal ideologies. Based on this informed speculation, the research provides recommendations to prospect a systemic design space for pandemic responses.

Keywords: Design space, COVID-19, Orders of Design, Sociotechnical Controversy, Systemic relations.

INTRODUCTION

Design activity has developed in, at least, four orders of design across the XXth century (Buchanan, 1992, 2001, 2019a). In recent years, the fourth (systemic) order is becoming increasingly prominent in design discourse (Vôute *et al.,* 2020; Buchanan, 2019b; Dorst, 2019; Jones, 2014; Ryan, 2014; Sevaldson, 2013). The discourse goes by saying that it is possible to effect systemic changes in society through local interventions that may be scaled up. Various design approaches emerged in recent years to underscore such design interventions (Engeler, 2017; Irwin, 2015; Jones, 2014; Vassão, 2017; 2008; Manzini, 2015; 2008). There are no empirical studies that look at the dissemination of systemic approaches in design activity beyond the educational, to the best of our knowledge.

A major challenge for empirical studies at the fourth order is understanding the design space: who is proposing what. Since multiple actors compete to shape the social and technical relations under design, this space can be considered a sociotechnical controversy (Venturini et al., 2015; Venturini, 2010). In a controversy, what is considered a problem for an actor may be a solution for another, and vice-versa. Since the design space is socially produced (Van Amstel *et al.,* 2016), actors act in relation to each other, generating design patterns (Alexander, 1979) as much as justification patterns (Boltanski & Thévenot, 1991).

A case in point is the COVID-19 pandemic, which posed an urgent call for thinking about systemic relations (Macedo *et al*., 2020; Hynes *et al.,* 2020; Bradley *et al.,* 2020). The virus spread quickly across the globe due to systemic problems that were not being appropriately tackled by society, such as meat consumption, health inequality, global mobility, and work

precarity (Santos 2020; Macedo *et al.,* 2020). Some actors denied that these problems had anything to do with the pandemic, while others questioned the quick solutions, such as city lockdowns and mobile surveillance. A sociotechnical controversy of large proportions arose.

This research looks at this sociotechnical controversy as a design space to verify the extent of the supposed expansion of design activity towards the fourth order. The expansion is summarized in the next section. Then, in section 2, we introduce the concept of design space and a mapping method. A complementary method is added in section 3: controversy mapping. Section 4 describes how we combined these two methods to map the design responses to the COVID-19 pandemic. Section 5 describes the results of this mapping activity. The final session discusses these results and provides recommendations for a systemic design space for pandemic responses.

1. THE EXPANSION OF DESIGN ACTIVITY TOWARDS THE SYSTEMIC ORDER

Design generally refers to the field of knowledge and the shared *praxis* among different domains that consider project development as a *loci* to create and apply knowledge (Redström, 2006; Cross, 1982). For this study, design refers to a human activity (designing) that occurs in multiple professions, such as architecture, industrial design, graphic design, and engineering (Dilnot, 1982; Van Amstel, 2015). There is disagreement on what constitutes this activity and how it develops across history. Recent studies speak of an expansion of design activity beyond design professions' boundaries (Dorst, 2019; Kimbell, 2011; 2012; Brown and Katz, 2011; Buchanan, 1992).

Richard Buchanan's doctrine of placements (1992) has become an influential explanation for this expansion. The author believes that design activity cultivates an integrative way of thinking capable of switching from one conceptual underpinning to another, effectively connecting disparate ideas. Instead of fixed ontological categories, design activity makes use of flexible placements such as *signs*, *things*, *actions*, and *thoughts*, which are often used by designers to define a scope of intervention in reality (Buchanan, 1992).

Later, Buchanan (2001; 2019a) refashioned his doctrine of placements as orders of design, this time relating them to common problems faced in design practice. The first-order (*signs*) deals with problems of communication, while the second (*things*) deals with problems of construction. The third (*actions*) deals with problems of action and the fourth (*thought*) deals with problems of integration. These orders of design correspond roughly to the historical development of design specializations: graphic designers work mostly in the first-order, industrial designers in the second, and interaction/service designers in the third-order. The fourth order is an exception to that because integration problems typically push designers to the opposite side of specialization.

There is not yet an established specialization in the fourth order, but there are already design approaches focused on that order: prospective design (Engeler, 2017), transition design (Irwin, 2015), systemic design (Jones, 2014), metadesign (Vassão, 2008; 2017), and design for social innovation (Manzini, 2008; 2015). These do not have fixed design objects to work with, such as the specializations above. Instead, they share a relational ontology (Escobar, 2018) focused more on the process of designing rather than on the products of designing.

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A common feature for these approaches is the inclusion of various stakeholders, users, oppressed people, non-humans, and other actors that are often left out from design processes (Buchanan, 2019b). Such inclusion raises many problems that are not easily definable or solvable within the scope of existing design activity, the so-called wicked problems (Buchanan, 1992). As a response to that, designers typically expand their activity to include knowledge and practices from other fields. Given this constant expansion, some scholars consider the systemic order to be pushing the design profession towards a more integrative and less specialized profile, capable of dealing with a large variety of issues (Buchanan, 2019b; Engeler, 2017; Ceschin and Gaziulusoy, 2016). Thus, the expansion of design activity implies an expansion of the problems and solutions typically considered.

2. DESIGN SPACE MAPPING

The concept of design space is often used to observe and manage the expansion of problems and solutions in a given project, but from the perspective of social production (Van Amstel, 2016), it can also be used to describe the expansion of design activity to new objects and domains. Early studies about design space divided the concept into problem space and solution space (Newell and Simon, 1972). Subsequent studies defined the design space as a sum of all the information that is considered in the design of an artifact (Hassenzahl and Weser, 2000), such as its general purpose and context of use (Bevan and MacLeod, 1994), allowing the designer to explore alternative solutions by reframing problems and comparing solutions to each other (Chien and Flemming, 2002).

Since design problems lack initial states — a set of acceptable criteria for judging what a good idea is (Goldschmidt, 1997), designers must create new states to understand previous ones, through derivation or differentiation. Thus, the design space can be mapped as a network of cognitive states, each state being either a solution or a problem (Goldschmidt, 1997). As designers explore this network, they constantly expand the means of representing problems and solutions (Goldschmidt, 2006).

Previous works called for conceptual tools that navigates problem space and solution space separately (Woodbury and Burrow, 2006; Westerlund, 2005; Chien and Flemming, 2002). We propose a conceptual tool that traces problems and solutions in a single graph to grasp systemic relations within the design space (Figure 1). The connections between nodes reveal which solution addresses which problem, in a simplified design pattern formation (Alexander, 1979).

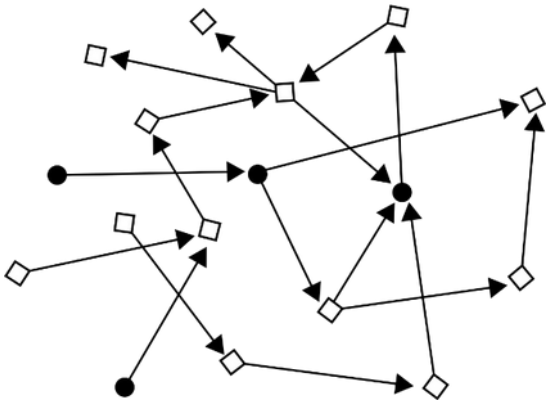

Figure 1: Design space mapping: a conceptual tool based on a directed graph of interconnected problems (dark circle) and solutions (white squares). Edges' direction represents the nature of the design move. Problematizing edges point towards problems, whereas solving edges point towards solutions.

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This conceptual tool can map the social production of design space (Van Amstel *et al*., 2016) across various projects, including the differences between them. Design space becomes, then, rather controversial, as multiple actors dispute which problems are worth solving and which solutions are worth problematizing. This shift from logical to controversial design space is necessary to grasp the fourth order, as public deliberation is expected. We turn Science & Technology Studies to complement our understanding of public deliberation in this context.

3. SOCIOTECHNICAL CONTROVERSY MAPPING

According to Manos & Wilkinson (2016), controversy is installed in the public sphere when there are doubts about the effects, scope, and technical limits of a firmly established phenomenon. A sociotechnical controversy emerges when issues are inextricably technical and social, unfolding through an unpredictable trajectory of interdependent events and actors (Callon et. al., 2009; Manos & Wilkinson, 2016).

Sociotechnical controversies are theorized in Actor-Network Theory (ANT) (Latour, 2005) and Convention Theory (CT) (Wilkinson, 1999). ANT deals with how humans and non-humans actors act together through a network assemblage that depends on other assemblages. CT deals with how rules, norms, and conventions are built and validated in specific activities. Rules are a mechanism for clarifying what is socially accepted and allowed, a set of norms on solving and accommodating responses to problems. Tensions emerge from convention-breaking, like the lack of communication between multidisciplinary groups.

Boltanski & Thévenot (1991) propose two CT principles. The first principle says that common notions such as well-being regulate collective action as parameters for qualifying understandings based on justifications. The second principle states that concrete and subjective instruments, such as theories or arguments, and their meanings within each situation, also determine action. These two principles point to the constant reframing of the world produced by actors, and the instruments used to understand their reality.

Based on CT and ANT, Tommaso Venturini proposed cartography of controversies or, simply, controversy mapping as a method for studying sociotechnical controversies (2012, 2015). The first step of the method is to read a phenomenon by tracing its genealogy, converting it into a visual representation. After describing it, using charts, texts, or numbers, the researcher links it to other phenomena, generating a social graph. The graph nodes may represent actors, proposals, facts, concerns, or anything that is part of the controversy (Venturini, 2012). Controversy mapping shares with design space mapping the graph as a means of visualizing possibilities. However, it adds an interested view on actors, problems, and solutions, which may reveal the historical genealogy of the design space and its prospects for the future.

4. RESEARCH METHOD

According to CT, one can say that designers and institutions produce design space according to their interests and justifications: problems — an existing thing that must be changed — and solutions — something new that may change the existing situation. And according to ANT, this space can be considered a sociotechnical controversy in itself. The design space around COVID-19 responses is a case in point, with multiple actors solving multiple problems, with common and individual interests. The systemic impact of the pandemic

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(Macedo *et al*., 2020; Hynes *et al*., 2020; Bradley *et al.,* 2020) suggests that there should be plenty of fourth order responses in this design space, if design is really expanding to that direction.

Looking for evidence of this expansion, this research poses the following questions about the COVID-19 design space: a) What is the distribution of responses across the four orders of design? b) How do responses justify each other? c) How do actors position themselves in this controversy? To answer these questions, we combined design space mapping with controversy mapping to generate a hybrid method called *controversial design space mapping*. The method aims to trace the historical genealogy of a design space, revealing its actors and their interests.

The empirical data comes from a set of 113 web pages that describes design responses to the COVID-19 pandemic. The web pages were selected from the pool of links shared by websites representing the international design community's current interests, such as Dezeen, Designboom, Archtrends, Fast Company, and others. In addition to these, specific websites aimed at collecting and sharing COVID-19 design responses were included[1]. The first entry dates from the 2nd of February, 2020, and the last to the 6th of June, 2020. The search and selection of responses were not systematically controlled due to the lack of standardization in practitioners' publications and the lack of scientific publications on the subject (which is the gap filled by this special issue). This sample does not statistically represent the international design community in any way, yet it serves as a convenience sampling for a prospective study.

Each web page describes one or several design responses. The responses were registered in a database with two tables: *elements* and *connections*. The *elements* table had the following metadata: URL, short label, description, actors who proposed the response, actor type, response type (problem or solution), and the highest order of design we think the response reached. The *connections* table stored the IDs of the connected elements, categorized into two types: "is problematizing" if the entry problematizes another entry and "is solving" if an entry solves another entry. The obvious connection is between a solution entry and a problem entry, yet the less obvious was also important for this study: a) connections that problematized solutions; b) connections that further problematized an existing problem; and c) connections that solved a shortcoming of a previous solution, e.g. a derived solution.

From these two tables, we generated visual graphs using an online visualization tool (http://kumu.io). The graphs displayed the elements and connections in relation to each other using force-directed, a plotting algorithm with a central gravitational force, a particle charge that pulls nodes apart, and a connection force that attracts them. The tool offers the possibility of zooming in and out, filtering entries and connections, calculating graph metrics, and changing graphic properties based on these metrics. We interpreted these graphs to find design patterns using design theory and patterns of interests using CT and ANT. The research method can be roughly summarized by these steps, not always followed in this same order:

- **Identify responses**: search the web for COVID-19 design responses and add them to the database with a unique ID;
- **Distinguish responses**: classify responses as either problem or solution;

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- **Connect responses**: plot responses, identify design patterns, and populate the connections table with the IDs of related responses;

- **Place responses**: identify the highest order of design achieved by the response and add as a numeric category (1-4);

- **Position actors**: identify the main actor behind the response and classify it according to a taxonomy that evolved throughout the process. The final categories were University, Individual, Government, Collective, Company, Non-profit, or News. The responses' connections now reveal patterns of interest.

The interpretation of these maps followed standard qualitative data analysis principles, informed by ANT and CT, and complemented by specific graph analysis techniques, such as social network analysis and visual insight. In the next session, the research questions are answered with the findings.

5. RESULTS

5.1. What is the distribution of responses across the four orders of design?

Of 113 design responses, 32 are in the first order of design, 60 in the second-order, and 9 for the third and 12 for the fourth order. These numbers already suggest that the urgent systemic issues posed by COVID-19 are not being properly addressed. The analysis of the design space generated four graphs[2]. When comparing the first and the second graphs, respectively, the problem space (Figure 2) and the solution space (Figure 3), it becomes clear that the fourth order is unbalanced: there are 12 problems and only 1 solution ("Adapted housing"). Even the third-order, associated with established design specializations, attracted a few solutions. The solutions are concentrated in the first and the second-orders. The most relevant solution (with the highest connectivity degree) is "Personal Protective Space" and the most relevant problem is "Social distancing is awkward".

The first-order has four times more solutions (27) than problems (5), while the second-order has three times more solutions (45) than problems (15). As we get to the third and fourth order, there is an inversion on this tendency. There are more problems in the third (6) and fourth order (11) than solutions in the third (3) and the fourth order (1). The problem space (Figure 2) has a more balanced distribution of ideas across the orders than the solution space (Figure 3). Nevertheless, the graph reveals that some solutions and problems appear between the orders due to their mutual connections, suggesting that ideas are placed and replaced in multiple orders, as Buchanan (2001) stated. For example, there are hybrid solutions across the first and second-order, such as "Assessment tool", "Distance grid on a plaza", and "Open design platform" (Figure 3). These solutions are overshadowed by the problems that cut across the four orders of design when a single graph represents problem space and solution space. Problems are more connected than solutions, therefore, they stand out in the central area of the graph visualization (Figure 4).

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Figure 2. The problem space of COVID-19 with the four orders of design. Node size is proportional to the connectivity degree.

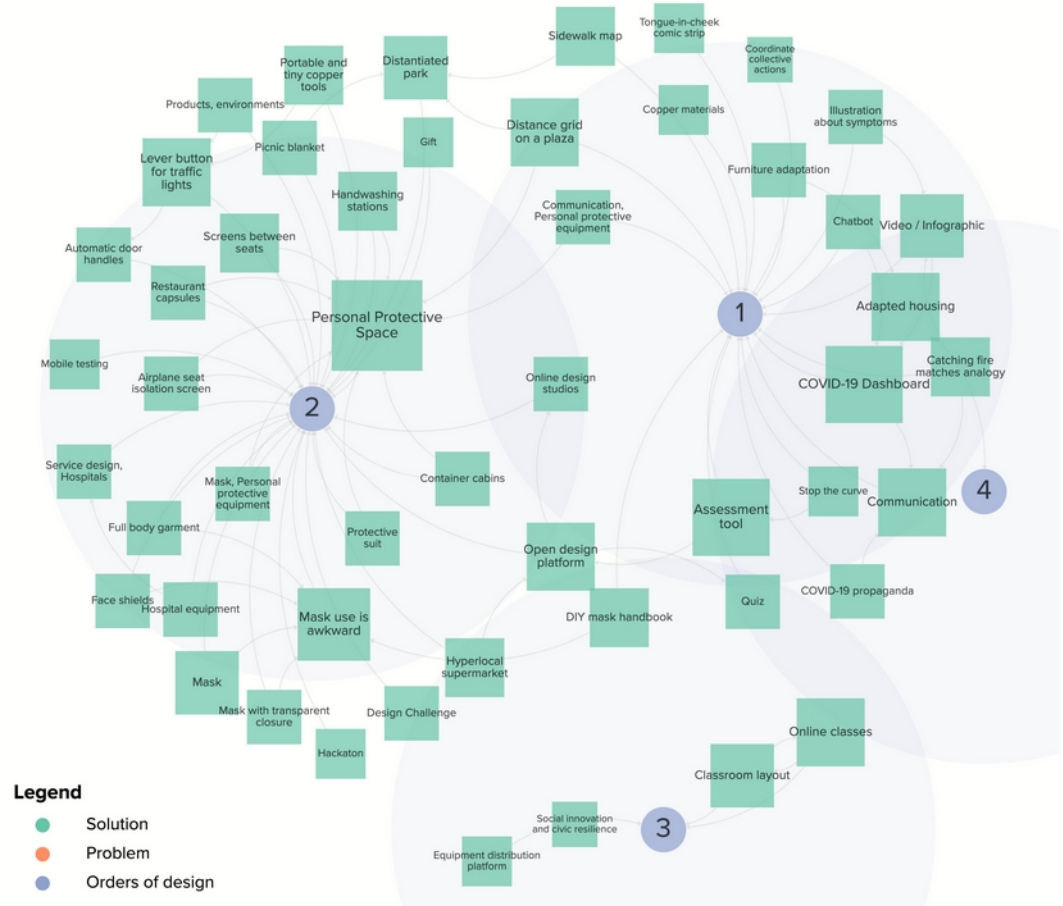

Figure 3. The solution space of COVID-19 with the four orders of design. Node size is proportional to the connectivity degree.

Van Amstel, F. M. C., Guimarães, C. & Botter, F. (2021). Prospecting a systemic design space for pandemic responses. *Strategic Design Research Journal*. Volume 14, number 01, January – April 2021. 66-80. DOI: 10.4013/sdrj.2021.141.06

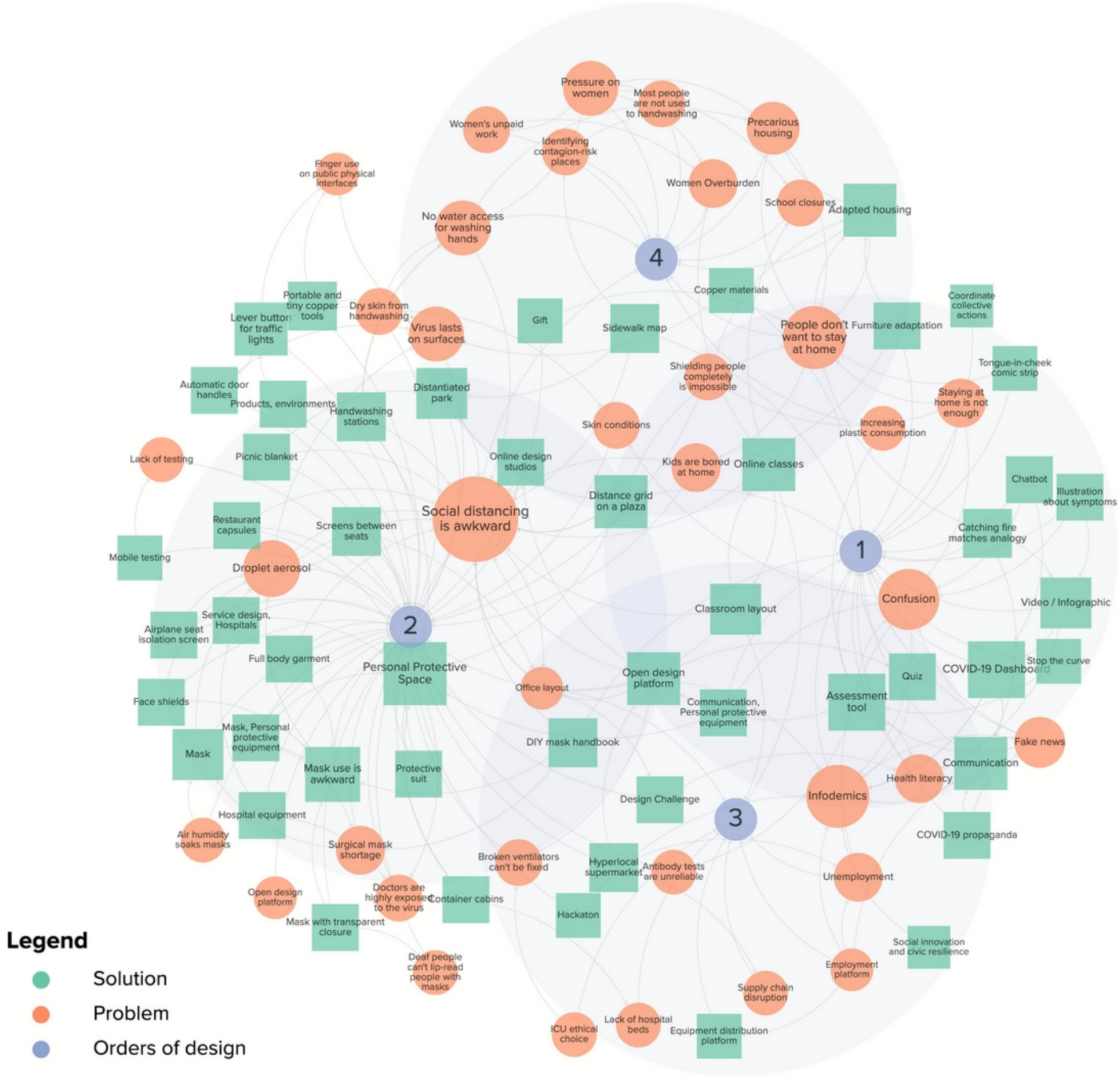

Figure 4 Design patterns across the four orders of design.

5.2. The genealogy of design responses

The connection between responses also reveal their logical origins. If a solution connects to a problem, it is possible to infer that one came after the other. However, this is not always the case. Solutions are often introduced in the design space without proper justification. Also, problems may remain in the design space without an adequate solution. Problems may be further problematized as much as solutions may be further solutionized through derivations. Problems and solutions can also appear in a chain of justifications that mutually reinforce each other. Figure 5 shows 15 justification patterns identified in the design space with the community detection SLPA algorithm (Figure 5).

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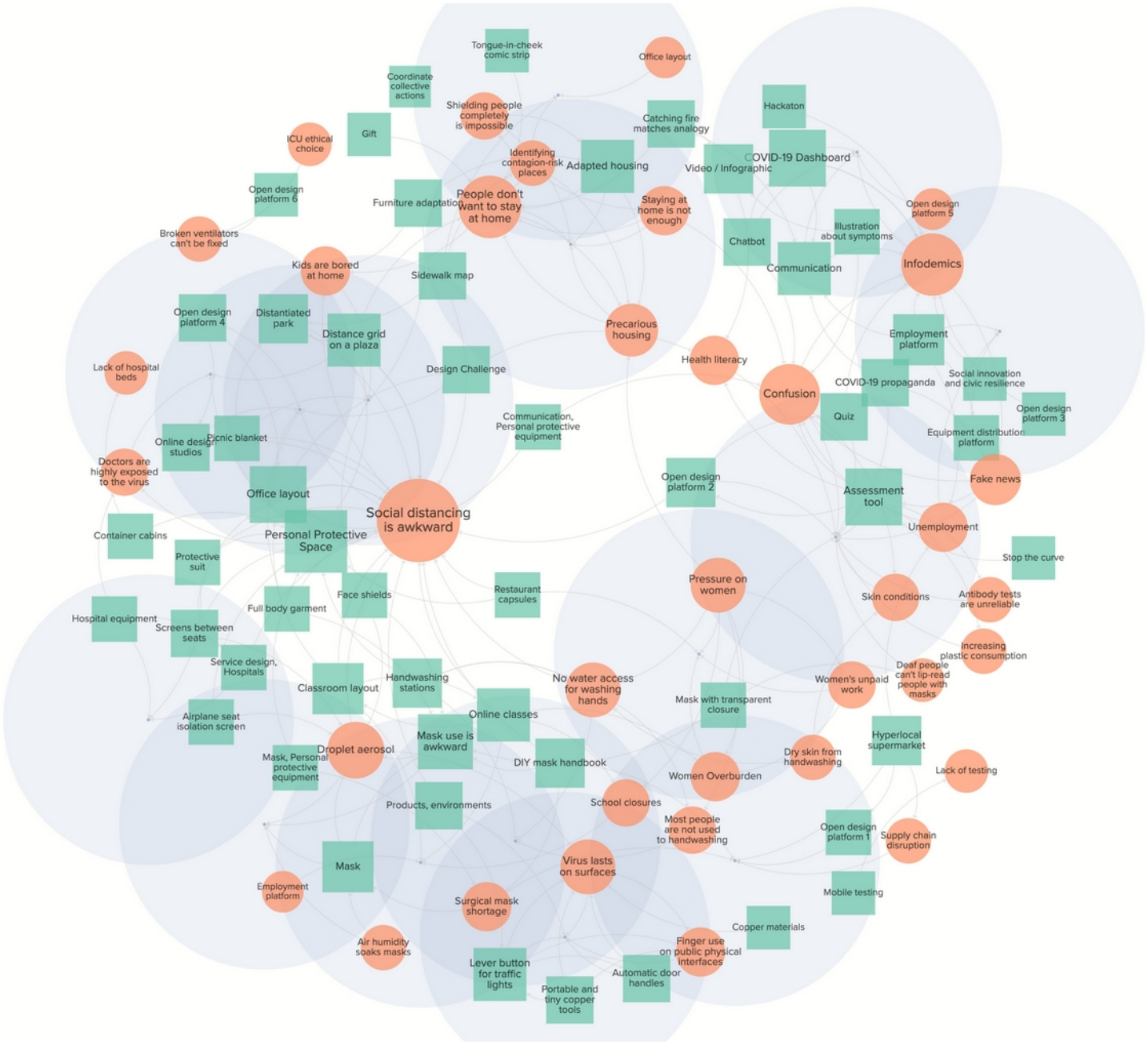

Figure 5: Justification patterns in the design space.

10 problems are waiting for solutions around the map and 6 problems justify a handful of solutions. Most solutions, however, are unjustified. Among all 59 solutions, 18 are not connected to any problem, and from those, 31 are connected to 1 problem only, meaning solutions are targeting specific issues without proper problematizing. For example, the solution "Mask with transparent closure" is supposed to solve the problem "Deaf people can't lip read people wearing masks", however, deaf people communicate mainly through signs and only a few can read lips (Fernandes, 2012).

5.3. The actors' positioning within the design space

Revealing the actors that posed these problems and solutions to the design space is essential to understand the underlying dynamics of a sociotechnical controversy: the conflicts of interest (Venturini, 2012). Actors are not problematizing or solutionizing for the sake of the design space's internal logic. If that would be the case, the previously discussed graphs would be much more homogeneous and focused on urgent matters. Actors pose problems and propose solutions to gather visibility, generate partnerships, collect resources, attract

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customers, or instil debate. Often, these interests cannot be mutually achieved, generating conflicts.

Handling conflicts of interest in the design space is challenging because most of them are vested or implicit. However, if an actor is not addressing a problem, it means the actor is not interested in that problem at that particular moment. Conversely, if an actor is proposing many solutions to the same problem, it means that the actor is very interested. If an actor is generating many problems or many solutions in the design space, the actor is trying to make itself interesting for other actors so that other actors will depend on it in the future if they want to navigate the design space (Latour, 2005).

Figure 6: Actors' positioning in relation to the four orders of design.

The finding that News actors were the main problem-posers surprised us, as we expected the Government or Universities to play this role, given their leading role in dealing with pandemics. It seems that the News is profiting from and, at the same time, trying to solve the "Infodemics" problem. Companies are mainly interested in solution-finding and may not understand well the problems they are dealing with. The solutions developed by them reveal an interest in selling products or services related to the pandemic, at the second and third-orders of design, respectively (Figure 6).

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We could not find any University response in the fourth order. Governments provide only two responses in the third-order ("Online classes" and "Employment platform") and none in the fourth. The short interest in the fourth order may be attributed to the lack of clear business models, the low dissemination of systemic design approaches, the difficulty of conducting interventions, the timescale horizon, and other explanations we can merely speculate about at this moment.

This study inherits the limitations of controversy mapping (Venturini, 2012, p.12): "1) search engines are not the web; 2) the web is not the Internet; 3. the Internet is not the digital; 4. the digital is not the world". This means that our maps cannot be taken as an accurate representation of the design activity associated with COVID-19. There is probably a huge number of design responses that were not published on the web, and among those, only a small part was linked to the websites we consulted. Furthermore, there are design responses that are not identified as *designerly* in any way. The map accounts, thus, for a largely unknown terrain. This is a standard and fair limitation for a prospective mapping conducted on short notice, like the design responses themselves. This mapping may also be considered another design response, subject to all the implications mentioned here.

6. DISCUSSION

The analysis of these maps suggests that if the socially produced design space is indeed expanding towards the systemic level, this expansion is not meeting the pace required by the COVID-19 pandemic. There were fewer design responses associated with the fourth and third-orders comparing to the second and first-orders. A possible explanation for that is the lack of depth in problematizing the pandemic. The design community is trying to tame wicked problems in the COVID-19 design space one by one, unaware or unable to tap into the systemic relations necessary to fight the pandemic in multi-actor cooperations effectively. The design space reproduces the Western cultures' tendency to abandon collectivity and enhance individuality. In this context, this tendency raises a vigorous contradiction because, as we know from previous studies, pandemics must be fought with systemic and collective actions (Macedo *et. al*., 2020; Hynes *et al*., 2020; Bradley *et al*., 2020).

The News emerged as a key actor in problematizing design responses in all four orders, whereas Non-profit led the discussion in the fourth order of design. We expected that Governments and Universities would also play a similar role, but we found fewer responses from them, mostly at the second and third-order of design. Given their privileged position in looking at wicked problems from a broad perspective, we think these actors should demonstrate more leadership in pushing the design community towards the systemic level.

Universities are the place for knowledge construction *par excellence*. The fact that the design initiatives promoted by higher education institutions are not representative may be an indication that the prevailing scientific paradigms around the world is marked by specialization, which targets the micro scale and neglects the macro scale. However, greater engagement on the part of public administrations proves to be essential if sociotechnical systems are to be changed. One-off actions are as necessary as large-scale actions, as became evident in some of the fourth order problems. The fact that public administrations exempt themselves from thinking of solutions to the problems of the fourth order — but, above all, from problematizing about them — is very representative of the neoliberal agenda that in recent years seems to be strengthening and intensifying in all corners of the planet, including

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in the design field (Williams, 2019). From another point of view, this absence may also reflect a general lack of Government interest in design.

Another explanation for the lack of fourth order responses is their time scale. These usually manifest in the scale of the year, the decade, and even the century. The variety of factors considered at these scales is considerably larger than in the previous orders, hence, designing for systemic relations did not yield many results in the first half a year of the COVID-19 pandemic. Nevertheless, systemic design approaches could have anticipated dealing with pandemics before having to deal with them on short notice. The current state of systemic risk management poses an anticipatory challenge to designers: when they are needed to act at the systemic level, they have to be prepared right away because there won't be enough time to get ready.

The controversial design space mapping demonstrated to be useful to identify the state of a certain community in terms of their thoughts and projects about an urgent reality. Further, these maps may be read as a prospect on new avenues for design activity, as proposed by the literature and partially confirmed by our data and its interpretation. We provide, then, some prospective recommendations for a systemic design space for future pandemic responses: a) to recognize multiple actors and positions when entering the design space; b) to consider existing problems and solutions before proposing supposedly new ones; c) taking problematization as seriously as solutionizing; d) making sense of the design space as a sociotechnical controversy with interested actors. Further research may check if these recommendations do apply to any social production of design space in the fourth order of design.

Future studies could repeat this same mapping exercise, including academic publications in the sampling, as they get published. Beyond mapping, the intersection between design theory, CT, and ANT may provide interesting explanations for the social production of design space. Further work on that could address the puzzling questions that popped up in our study as outside of the scope, such as: to what extent non-humans participate in shaping our thoughts, environments, and systems? Can they be considered producers of design space? Is there an independent non-human design activity? Can or should this activity be controlled by human actors? These are difficult questions that bring another dimension to the discussion on the expansion of design activity towards the fourth order of design.

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ENDNOTES

[1] Web sources containing COVID-19 design responses: https://designvanguard.org | https://www.covidinnovations.com | https://covid19designchallenge.org/ | https://www.fountainofhygiene.com | https://emergencydesigncollective.com

[2] The interactive map that generated the visual graphs of Figures 2-6 is available on https://kumu.io/usabilidoido/covid-19-controversial-design-space-mapping

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