
Choice Posture, Architecture, and Infrastructure: Systemic Behavioral Design for Public Health Policy

Ruth Schmidt
Zeya Chen
Veronica Paz Soldan

Keywords

Design for policy
Systemic policy design
Behavioral design
Choice infrastructure
Choice triad model
Public health policy

Received

January 31, 2022

Accepted

August 3, 2022

RUTH SCHMIDT
Institute of Design, Illinois Institute of
Technology, USA
(corresponding author)
schmidt@id.iit.edu

ZEYA CHEN
Institute of Design, Illinois Institute of
Technology, USA
zchen103@id.iit.edu

VERONICA PAZ SOLDAN
Institute of Design, Illinois Institute of
Technology, USA
vpazsoldan@id.iit.edu

Abstract

The demands of many public health contexts and challenges call for conditions that foster effective decision making. Policy designers must make appropriate choices appear viable, accessible, and beneficial. They can do this by harnessing transdisciplinary knowledge about behavioral tendencies, simultaneously integrating insights into end users and non-human agents, and employing design methods for system-level solutions. We propose a "choice triad" model to help practitioners frame transdisciplinary approaches to complex public health challenges and design effective conditions for choice. It has three lenses: *choice posture*, to reveal human and non-human agents' predispositions and inclinations; *choice architecture*, to improve immediate choice environments and encourage preferred actions; and *choice infrastructure*, to reveal the underlying system structures, processes, and policies that shape how potential public health solutions are accessed and supported. This approach promises to augment traditional design tools and expand current conceptions of available "economies of choice" when crafting behavioral public policy solutions. In combination, these lenses can provide a new conceptual syntax and working model to diagnose and develop solutions within complex public health settings. We introduce two examples to illustrate this model: the water crisis in Flint, Michigan, and Covid-19 vaccination efforts in the United States.

© 2022 Ruth Schmidt, Zeya Chen, and Veronica Paz Soldan.

Published by Elsevier B.V. on behalf of Tongji University. This is an open access article published under the CC BY-NC-ND license (<https://creativecommons.org/licenses/by/4.0>).

Peer review under responsibility of Tongji University.

<http://www.sciencedirect.com/journal/she-ji-the-journal-of-design-economics-and-innovation>
<https://doi.org/10.1016/j.sheji.2022.08.002>

- 1 Horst W. J. Rittel and Melvin Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences* 4 (June 1973): 155–69, <https://doi.org/10.1007/BF01405730>.
- 2 Lucy Kimbell, "Design in the Time of Policy Problems," in *Proceedings of DRS 2016: Design Research Society 50th Anniversary Conference* (Brighton, UK, June 27–30, 2016), 8, <https://www.drs2016.org/498>.
- 3 Donella H. Meadows, *Leverage Points: Places to Intervene in a System* (North Charleston, SC: Sustainability Institute, 1999); William M. Trochim et al., "Practical Challenges of Systems Thinking and Modeling in Public Health," *American Journal of Public Health* 96, no. 3 (2006): 538–46, <https://doi.org/10.2105/AJPH.2005.066001>.
- 4 Michael Sanders, Veerle Snijders, and Michael Hallsworth, "Behavioural Science and Policy: Where Are We Now and Where Are We Going?," *Behavioural Public Policy* 2, no. 2 (2018): 146, <https://doi.org/10.1017/bpp.2018.17>; Benjamin Ewert, "Moving beyond the Obsession with Nudging Individual Behaviour: Towards a Broader Understanding of Behavioural Public Policy," *Public Policy and Administration* 35, no. 3 (2020): 340, <https://doi.org/10.1177/0952076719889090>; Ruth Schmidt and Katelyn Stenger, "Behavioral Brittleness: The Case for Strategic Behavioral Public Policy," *Behavioural Public Policy* (May 7, 2021): 1–26, <https://doi.org/10.1017/bpp.2021.16>.
- 5 Jan vom Brocke et al., "Process Science: The Interdisciplinary Study of Continuous Change" (working paper, posted by SSRN, September 7, 2021), 1–9. <https://doi.org/10.2139/ssrn.3916817>.
- 6 Harold W Kohl et al., "The Pandemic of Physical Inactivity: Global Action for Public Health," *Lancet* 380, no. 9838 (2012): 298, [https://doi.org/10.1016/S0140-6736\(12\)60898-8](https://doi.org/10.1016/S0140-6736(12)60898-8).
- 7 Alessandra N. Bazzano et al., "Human-Centred Design in Global Health: A Scoping Review of Applications and Contexts," *PLoS One* 12, no. 11 (2017): e0186744, <https://doi.org/10.1371/journal.pone.0186744>.

Introduction

Many public health challenges are wicked problems¹ characterized by complexity and adaptation, decision making amidst uncertainty, and wide variations in context. Adopting a multidimensional perspective is a beneficial way of addressing these challenges. Such dimensions may include human-centered design strategies, for example, that contribute bottom-up insight into latent needs and wants through qualitative user research and participatory design,² and systems design methodologies that consider infrastructure, leverage points, and multi-level problem solving, and account for the agency of non-humans.³ More recently, and in addition, applied behavioral science has been used to inform behavioral change approaches that increase the chances of policies being adopted and acted upon.⁴

Integrating these methodological approaches, however, is no easy task. Efforts to combine inductive and abductive problem solving methodologies or modes of inquiry can cause tensions to arise.⁵ This leads to a kind of oversimplification that eliminates or deprioritizes important nuances. For example, applied behavioral approaches that narrowly target immediate choice environments may neglect infrastructural considerations that impact system-level implementation and functionality of a public health intervention.⁶ System approaches that focus primarily on higher-level structures may fail to systematically capture the relevant spectrum of specific human contexts and motivations that encourage or discourage public health behaviors. And design methods that capture end recipients' critical latent needs but lack a systems view may overlook the role that the necessary infrastructure will play when building or evaluating success at scale.⁷

This suggests that successful approaches to designing public health policy lie not in doubling down on one discipline, but in integrating them more effectively. In this article we propose a hybrid conceptual model and framing device — a "choice triad" of *choice posture*, *choice architecture*, and *choice infrastructure* — to inform the development of solutions in complex contexts such as public health. We first introduce how strategic design, behavioral science, and systems approaches contribute to public health challenges, and describe how choice posture, architecture, and infrastructure can frame these issues in new ways. We then illustrate the triad's diagnostic, generative, and evaluative applications in two contexts — the US Covid-19 vaccination program and the 2014 water contamination crisis in Flint, Michigan — and conclude with potential design implications and steps for further inquiry.

Three Disciplines, Three Directions for Public Health Policy

Public health's wide range of human, scientific, technological, and social concerns and high-risk or high-uncertainty contexts present a uniquely difficult set of challenges. Confoundingly, evidence of success is often signified by an absence of negative outcomes. Some approaches have historically relied on evidence-based methodologies to increase the chances of an intervention's success. But policy designers increasingly recognize that public health challenges are characterized by self-organizing agents with emergent

- 8 Ted Carmichael and Mirsad Hadžikadić, "The Fundamentals of Complex Adaptive Systems," in *Complex Adaptive Systems: Views from the Physical, Natural, and Social Sciences*, ed. Ted Carmichael, Andrew J. Collins, and Mirsad Hadžikadić (Cham: Springer, 2019), 2, https://doi.org/10.1007/978-3-030-20309-2_1.
- 9 Harry Rutter et al., "The Need for a Complex Systems Model of Evidence for Public Health," *Lancet* 390, no. 10112 (2017): 2602–4, [https://doi.org/10.1016/S0140-6736\(17\)31267-9](https://doi.org/10.1016/S0140-6736(17)31267-9); Declan Terence Bradley et al., "A Systems Approach to Preventing and Responding to COVID-19," *EClinicalMedicine* 21 (April 2020): article no. 100325, <https://doi.org/10.1016/j.eclinm.2020.100325>; Trisha Greenhalgh, "Will COVID-19 Be Evidence-Based Medicine's Nemesis?," *PLoS Medicine* 17, no. 6 (2020): e1003266, <https://doi.org/10.1371/journal.pmed.1003266>.
- 10 Susan Michie, "Implementation Science: Understanding Behaviour Change and Maintenance," *BMC Health Services Research* 14, no. S2 (2014): 09, <https://doi.org/10.1186/1472-6963-14-S2-09>; Susan Michie, Maartje M. van Stralen, and Robert West, "The Behaviour Change Wheel: A New Method for Characterising and Designing Behaviour Change Interventions," *Implementation Science* 6, no. 1 (2011): article no. 42, <https://doi.org/10.1186/1748-5908-6-42>.
- 11 Bazzano et al., "Human-Centred Design in Global Health"; Marijke Melles, Armagan Albayrak, and Richard Goossens, "Innovating Health Care: Key Characteristics of Human-Centered Design," *International Journal for Quality in Health Care* 33, no. S1 (2021): 39, <https://doi.org/10.1093/intqhc/mzaa127>.
- 12 Gareth J. Hollands et al., "Altering Choice Architecture to Change Population Health Behaviour: A Large-Scale Conceptual and Empirical Scoping Review of Interventions Within Micro-environments," (report, published by University of Cambridge, 2013), <https://www.repository.cam.ac.uk/handle/1810/245108>.
- 13 Michael Howlett, "Challenges in Applying Design Thinking to Public Policy: Dealing with the Varieties of Policy Formulation and Their Vicissitudes," *Policy & Politics* 48, no. 1 (2020): 53, <https://doi.org/10.1332/030557319X15613699681219>.
- 14 Patrick Whitney and André Nogueira, "Cutting Cubes Out of Fog: The Whole View of Design," *She Ji: The Journal of Design, Economics, and Innovation* 6, no. 2 (2020): 129–56, <https://doi.org/10.1016/j.sheji.2020.04.001>.
- 15 Kimbell, "Design in the Time of Policy Problems," 12; Emma Blomkamp, "The

properties, responsiveness to feedback loops, and nonlinear dynamics.⁸ In other words, they are complex adaptive challenges—notoriously immune to analytical problem solving modes, linear models, or presumptions of causality.⁹

This has increasingly opened the door to alternative approaches that incorporate a range of disciplines when problem solving. One such discipline is implementation science, used to address behavioral and infrastructural barriers to adoption.¹⁰ Another is participatory design, whose methodologies invite people who will be impacted by the end result to participate during the framing and solution creation stages.¹¹ However, despite compelling evidence that domains such as strategic design, systems approaches, and applied behavioral science have the collective potential to advance more successful and strategic problem solving, each field still functions independently, in pedagogy and in practice, with respect to addressing public health challenges.¹² Each has specific strengths and weaknesses, as well.

Strategic Design

Human-centered and strategic design methods are familiar in public health, encompassing a wide range of tools to deliver bottom-up user insights and inform effective solutions for policy recipients.¹³ This includes employing frameworks that borrow from business strategy and innovation to achieve meaningful outcomes,¹⁴ as well as embracing richer forms of user engagement through participatory and co-design methods.¹⁵ In addition to bolstering insight into policy recipients, cultivating a deeper understanding of concerned populations can also increase the perceived legitimacy of solutions by allowing individuals' lived experiences and perspectives to serve as core drivers of the work, rather than merely as sources of data.¹⁶ In the context of healthcare, participatory design has been particularly influential in reframing and decentering the narratives and goals of health that historically have been seen as medical or technological rather than sociocultural.¹⁷ As a result, this kind of re-narrativizing has provided policymakers not only with the means to shape solutions and gain alignment, but also a way to interrogate what is worthy of being addressed.¹⁸

In contrast to the scientific method's hypothesis-based sensibilities, strategic design's more abductive, principles-driven approach—in which research findings are abstracted as a set of principles that must be reflected in solutions—allows it to balance specificity and flexibility.¹⁹ In addition, its forward-looking perspective, focused on *what could be* rather than a data-driven *what has been*, opens up new opportunities in addition to solving problems.²⁰ Nevertheless, design's general tendency toward bespoke solutions leaves the field open to criticism that it lacks rigor and replicability, and the focus of human-centered design on human wants has come under fire for neglecting critical non-human agents and outcomes. This tension is apparent in public health. Solutions that consider the contexts, preconceptions, and behavioral inclinations of healthcare providers and end recipients must also recognize how non-human agents—from microbes to medical substances to power dynamics—contribute to effective health care activities and outcomes.²¹

- Promise of Co-design for Public Policy," *Australian Journal of Public Administration* 77, no. 4 (2018): 732, <https://doi.org/10.1111/1467-8500.12310>.
- 16 Colette Einfeld and Emma Blomkamp, "Nudge and Co-design: Complementary or Contradictory Approaches to Policy Innovation?," *Policy Studies* 43, no. 5 (2021): 901–19, <https://doi.org/10.1080/01442872.2021.1879036>.
 - 17 Kimbell, "Design in the Time of Policy Problems," 8.
 - 18 Donald A. Schön and Martin Rein, *Frame Reflection: Toward the Resolution of Intractable Policy Controversies* (Boston: Basic Books, 1994).
 - 19 Richard Buchanan, "Systems Thinking and Design Thinking: The Search for Principles in the World We Are Making," *She Ji: The Journal of Design Economics and Innovation* 5, no. 2 (2019): 85–104, <https://doi.org/10.1016/j.sheji.2019.04.001>.
 - 20 Christian Bason, *Design for Policy* (New York: Routledge, 2016).
 - 21 Laura Forlano, "Posthumanism and Design," *She Ji: The Journal of Design, Economics, and Innovation* 3, no. 1 (2017): 18, <https://doi.org/10.1016/j.sheji.2017.08.001>.
 -
 - 22 "Nudge unit" is a common term in behavioral public policy. In this context, nudge unit is preferred to "nudges" as the point being made is not just that nudging is widespread but that it is incorporated into governance functions and policy institutions. See David Halpern and Michael Sanders, "Nudging by Government: Progress, Impact, & Lessons Learned," *Behavioral Science & Policy*, 2, no. 2 (2006): 53–65, specifically p. 55, available at <https://behavioralpolicy.org/wp-content/uploads/2017/06/Sanders-web.pdf>.
 - 23 OECD, *Tools and Ethics for Applied Behavioural Insights: The BASIC Toolkit* (Paris: OECD Publishing, 2019); Fabian Thomas et al, "Greening the Common Agricultural Policy: A Behavioural Perspective and Lab-in-the-Field Experiment in Germany," *European Review of Agricultural Economics* 46, no. 3 (2019): 367, <https://doi.org/10.1093/erae/jbz014>.
 - 24 Karen Glanz and Donald B. Bishop, "The Role of Behavioral Science Theory in Development and Implementation of Public Health Interventions," *Annual Review of Public Health* 31 (2010): 399–418, <https://doi.org/10.1146/annurev.publhealth.012809.103604>.
 - 25 Schmidt and Stenger, "Behavioral Brittleness," 2.

Behavioral Science and Behavioral Public Policy (BPP)

A mash-up of psychology and economics, the field of behavioral science provides a different perspective on human behavior by systematically identifying how cognitive biases cause behavior to deviate from rational economic principles of judgment and decision making. Applied behavioral science has been codified into governance and policymaking at an international scale in the form of "nudge units," employing behavioral insights to inform low cost and high-impact interventions.²² Imparting an improved choice architecture has contributed significantly to a wide range of policy challenges, including public hygiene efforts, green agricultural policy, and increasing access to democratic activities,²³ rendering it a welcome addition to public health policy development.²⁴

However, behavioral interventions that encourage preferable actions (e.g., eating healthy foods, saving money for retirement, encouraging organ donation) often focus on individuals, and typically intervene only at the last minute—the so-called "last mile" moment for behavioral change—rather than pursuing potential upstream causes of errant behaviors by targeting systems-level constructs. This can lead to a whittling away of complexity, removing externalities and systems-level inequities that can result in brittle solutions.²⁵ In addition, and despite recent efforts to systematize and scale interventions,²⁶ the challenge of generalizing and scaling solutions that address behavior is not so easily overcome, and optimizing solutions for specific contexts often makes them difficult to transplant elsewhere.²⁷

Despite a growing awareness that individual and cultural contexts, barriers, and beliefs inform how nudges are perceived or adopted,²⁸ behaviorally-informed policy tends to be centralized and top down, with development led by policy experts rather than recipients. However, a more open and recipient-centered approach may be gaining traction, evident in proposals that grant end users greater self-determination and recognize the situated nature of behavior.²⁹ Further still, looking beyond behavioral change and nudging to consider behavior within complex adaptive systems, promises to integrate behavioral science more strategically into public policy.³⁰

Systems Design

The integration of systems design and public policy over the last two decades is evidence of design's shift from a focus on artifacts and symbols toward a more mature role in crafting interactions at scale.³¹ Methods that help policymakers identify key leverage points in underlying technological, social, and cultural healthcare structures can reveal opportunities to recombine or repurpose existing infrastructures, helping human and non-human assemblages function more effectively and efficiently within current systems rather than presuming the need to create new ones from scratch.³² A systems design lens reveals permeable boundaries between hard technology and soft socio-cultural agents, which is also characteristic of many facets of health care: pharmacological agents such as antibiotics, or medical devices like insulin pumps and pacemakers are deeply integrative of human and non-human aspects. This insight reinforces systems design as a natural fit for applied public health contexts.³³ Further, systems approaches provide a secondary benefit

- 26 Philip Cash et al., "Designing Behaviour Change: A Behavioural Problem/Solution (BPS) Matrix," *International Journal of Design* 14, no. 2 (2020): 65–83, <http://www.ijdesign.org/index.php/IJDesign/article/view/3952>; Theresa M. Marteau et al., "Beyond Choice Architecture: Advancing the Science of Changing Behaviour at Scale," *BMC Public Health* 21, no. 1 (2021): article no. 1531, <https://doi.org/10.1186/s12889-021-11382-8>.
- 27 Mary Ann Bates and Rachel Glennerster, "The Generalizability Puzzle," *Stanford Social Innovation Review* 3 (2017): 51, <https://doi.org/10.48558/eyy5-3s89>.
- 28 Oliver P. Hauser, Francesca Gino, and Michael I. Norton, "Budging Beliefs, Nudging Behaviour," *Mind & Society* 17, no. 1 (2018): 17, <https://doi.org/10.1007/s11299-019-00200-9>.
- 29 Sanchayan Banerjee and Peter John, "Nudge Plus: Incorporating Reflection into Behavioral Public Policy," *Behavioural Public Policy* (2020): 5, <https://doi.org/10.1017/bpp.2021.6>; Samuli Reijula and Ralph Hertwig, "Self-Nudging and the Citizen Choice Architect," *Behavioural Public Policy* 6, no. 1 (2022): 121, <https://doi.org/10.1017/bpp.2020.5>.
- 30 Schmidt and Stenger, "Behavioral Brittleness," 4; Fiona Lambe et al., "Embracing Complexity: A Transdisciplinary Conceptual Framework for Understanding

in the form of enhanced system and solution sustainability, introducing new potential for generating and capturing additional forms of value over time.³⁴

The primary goal of public health initiatives, however, is to maximize system-level health; tensions can arise when interventions rely on individuals taking recommended courses of action at scale, given that the benefits to any given individual may seem insignificant or not readily apparent. Designing at a systems level requires addressing asymmetric uptake or other effects of public health policy that result from localized differences in available infrastructure and historical experiences at both individual and community levels.³⁵ This is of particular importance given that the design of underlying system conditions and social institutions shape many critical aspects of judgment, decision making, and behavior that are fundamental to desirable public health outcomes.³⁶ As such, it suggests that policy designers would benefit from tools that help them support effective decision making and action across diverse populations and individuals at scale when conceptualizing and developing public health policies.

The Choice Triad: Choice Posture, Choice Architecture, and Choice Infrastructure

The "choice triad" model (Figure 1) borrows from the three disciplines described above to propose three key dimensions when designing for judgment, decision making, and behavior in complex system contexts such as public health. The first is *choice posture*, representing the positionality and predisposition of human and non-human system agents. The second is *choice*

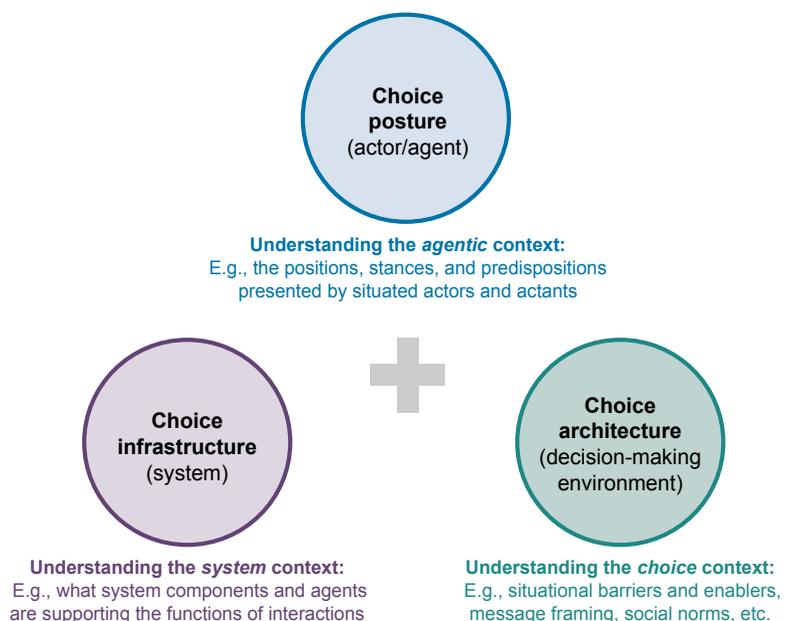


Figure 1
The choice triad of choice posture, choice architecture, and choice infrastructure.
© 2022 Ruth Schmidt, Zeya Chen, and Veronica Paz Soldan.

Behavior Change in the Context of Development-Focused Interventions," *World Development* 126 (February 2020): article no. 104703, <https://doi.org/10.1016/j.worlddev.2019.104703>; Bridget Malcolm and Mieke van der Bijl-Brouwer, "Developing a Systemic Design Practice to Support a Regulatory Agency in Addressing Complex Problems," in *Proceedings of RSD5 Symposium*, Toronto, 2016, available at <https://www.academia.edu/34793799/>.

- 31 Richard Buchanan, "Design Research and the New Learning," *Design Issues* 17, no. 4 (2001): 8, <https://doi.org/10.1162/07479360152681056>.
- 32 Josina Vink, Katarina Wetter-Edman, and Kaisa Koskela-Huotari, "Designerly Approaches for Catalyzing Change in Social Systems: A Social Structures Approach," *She Ji: The Journal of Design Economics and Innovation* 7, no. 2 (2021): 245, <https://doi.org/10.1016/j.sheji.2020.12.004>; Arwin van Buuren et al., "Improving Public Policy and Administration: Exploring the Potential of Design," *Policy and Politics* 48, no. 1 (2020): 16, <https://doi.org/10.1332/030557319X15579230420063>.
- 33 Christian Nold, "Towards a Socio-material Framework for Systems in Design" (working paper, UAL Social Design Institute, 2021), 1–30, <http://oro.open.ac.uk/79395/>.
-
- 34 Fabrizio Ceschin and İdil Gaziulusoy, *Design for Sustainability: A Multi-level Framework from Products to Socio-technical Systems* (Oxford: Routledge, 2019), <https://doi.org/10.4324/9780429456510>; Amina Pereno and Silvia Barbero, "Systemic Design for Territorial Enhancement: An Overview on Design Tools Supporting Socio-technical System Innovation," *Strategic Design Research Journal* 13, no. 2 (2020): 113–36, <https://doi.org/10.4013/sdrj.2020.132.02>.
- 35 Rutter et al., "Need for a Complex Systems Model."
- 36 Bradley et al., "Systems Approach."
-
- 37 Roderick J. Lawrence and Carole Després, "Futures of Transdisciplinarity," *Futures* 36, no. 4 (2004): 398, <https://doi.org/10.1016/j.futures.2003.10.005>.
- 38 Andrew Barry, Georgina Born, and Gisa Weszkalnys, "Logics of Interdisciplinarity," *Economy and Society* 37, no. 1 (2008): 20–49, <https://doi.org/10.1080/03085140701760841>.
- 39 Daniela Sangiorgi, "Transformative Services and Transformation Design," *International Journal of Design* 5, no. 2 (2011): 29–40, <http://www.ijdesign.org/>

architecture, or the design of decision making environments to encourage desirable behaviors. Finally, the third is *choice infrastructure*, in the form of underlying system armatures that support and extend behaviors or interventions. The model is deliberately conceived as transdisciplinary, a fusion of research disciplines in the interest of informing real-world problem solving,³⁷ rather than a multidisciplinary collaboration across siloed domains or an interdisciplinary synthetic merging of forms that retain their traditional boundaries.³⁸ In addition, the triad's conceptual model explicitly parallels transformative service design's focus on developing the *conditions* that underlie the effective delivery of services,³⁹ rather than centering or designing a specific service, product, or experience.

The nodes and the relationships between them are described below, then contextualized within two significant public health crises cases—the Covid-19 pandemic and the Flint water crisis—to more concretely illustrate how the triad relates to real-world challenges.

Choice Posture

Inspired in part by Actor-Network Theory (ANT), choice posture denotes the inclinations and predispositions of human and non-human agents within a system,⁴⁰ and how these stances contribute to individual agency and the power to act on other system agents. Agentic postures can take a range of forms. For example, a comfortable chair might present an inviting posture, a closed door demands privacy,⁴¹ an insurance statement naturally exudes intimidation, and algorithms are compelled to execute on pre-programmed goals.

However, posture is not unilateral, and can be fluid. While agents that share characteristics might display common attributes, their postures may reflect distinct histories, experiences and contexts, and—in the case of human agents—specific personal identities or aspirations. As a result, ostensibly similar agents may have different postures under the same circumstances, causing them to function differently than expected, or change over time as situations evolve. Designing for choice posture in a policy context thus compels designers to recognize that agents within systems are neither average nor generic, and that perceived postures may be shaped as much by legacy experience or social norms as by the particular moment of choice.⁴² For example, where behavioral public policy may presume a non-controversial disposition toward good health, or a shared belief that the police are here to help, a sharper choice posture lens would reveal that wildly variant contexts and experiences may reduce the overall effectiveness of policy interventions.⁴³

Agent postures can also be informed by second-order factors,⁴⁴ characterized less by their obvious features than by others' perceptions regarding their value or function.⁴⁵ For example, in situations of pluralistic ignorance, individuals who might otherwise vote for women or minority candidates may override their natural postures due to concerns over their preferred contender's presumed lack of electability in broader electorate.⁴⁶ This tendency can also manifest when attempting to overcome external perceptions, such as when ethnic foods are perceived as grotesque due to a lack

- [index.php/IJDesign/article/view/940/344](https://www.sheji.com/index.php/IJDesign/article/view/940/344);
- Mieke van der Bijl-Brouwer, "Designing for Social Infrastructures in Complex Service Systems: A Human-Centered and Social Systems Perspective on Service Design," *She Ji: The Journal of Design, Economics, and Innovation* 3, no. 3 (2017): 183–97, <https://doi.org/10.1016/j.sheji.2017.11.002>.
- 40 Ruth Schmidt, "A Model for Choice Infrastructure: Looking beyond Choice Architecture in Behavioral Public Policy," *Behavioural Public Policy* (2022): 1–26, <https://doi.org/10.1017/bpp.2021.44>.
- 41 Bruno Latour, "Where are the Missing Masses? A Sociology of Few Mundane Objects," in *Shaping Technology/Building Society: Studies in Sociotechnical Change*, ed. Wiebe E. Bijker and John Law (Cambridge, MA: MIT Press, 1992), 240, available at https://www.open.edu/openlearn/pluginfile.php/877054/mod_resource/content/3/dd308_1_missing_masses.pdf.
- 42 Schmidt, "Model for Choice Infrastructure," 8.
- 43 Pronobesh Banerjee et al., "Loss Is a Loss, Why Categorize It? Mental Accounting Across Cultures," *Journal of Consumer Behaviour* 18, no. 2 (2019): 79, <https://doi.org/10.1002/cb.1748>.
- 44 Sangiorgi, "Transformative Services," 32.
- 45 Cristina Bicchieri, "Norms, Conventions, and the Power of Expectations," in *Philosophy of Social Science: A New Introduction*, ed. Nancy Cartwright and Eleonora Montuschi (Oxford: Oxford University Press, 2014), 208–29, <https://repository.upenn.edu/belab/1/>.
- 46 Regina Bateson, "Strategic Discrimination," *Perspectives on Politics* 18, no. 4 (2020): 1068–87, <https://doi.org/10.1017/S153759272000242X>.
-
- 47 Judith A. Clair et al., "Marginal Memberships: Psychological Effects of Identity Ambiguity on Professionals Who Are Demographically Different from the Majority," *Organizational Psychology Review* 2, no. 1 (2012): 74, <https://doi.org/10.1177/2041386611429041>.
- 48 OECD, *Tools and Ethics*.
- 49 Sarah Forberger et al., "Nudging to Move: A Scoping Review of the Use of Choice Architecture Interventions to Promote Physical Activity in the General Population," *International Journal of Behavioral Nutrition and Physical Activity* 16, no. 1 (2019): article no. 77, p. 10, <https://doi.org/10.1186/s12966-019-0844-z>.
- 50 Tatiana Homonoff et al., "Skipping the Bag: The Intended and Unintended Consequences of Disposable Bag Regulation" (working paper 28499, National Bureau

of familiarity or when women leaders are presumed to be assistants or Black clinicians are presumed to be orderlies.⁴⁷ Given that public health situations often require navigating unfamiliar, threatening, and potentially judgmental agents, strategies to address second-order concerns are material to developing effective policy.

Embracing a postural frame also foregrounds that individual agents' standpoints, rather than some external or absolute truth, informs what good looks like, and further that these distinctions may constrain the perceived viability or feasibility of options. As a result, not only does heightened attention to agents' choice postures confer insight into particular embodied experiences that contribute to the construal of choice, but these postures can also provide cues to the presence of predispositions that have become normalized over time.

Choice Architecture

Notions from applied behavioral science—including choice architecture and nudging—have become widely used to describe the design of decision making environments that support and encourage preferred behaviors and address behavioral challenges. Outcomes designed this way often obtain results by reducing friction and cognitive effort in ways that make good decisions too easy not to take.⁴⁸ Not surprisingly, the thoughtful design of the choice environment is increasingly recognized as essential to the effective design of public health solutions, a conclusion bolstered by extensive empirical studies that provide evidence-based confidence in potential approaches.

Behavioral science interventions and improved choice architecture have historically focused on individuals and targeted behavioral change, rather than working at the level of systems. However, when these solutions fail to consider the extent to which perverse incentives or system forces hold systems in place at the expense of end users or policy recipients, even choice architecture that is well informed by evidence may fail to work as intended. For example, choice architecture interventions that encourage good health through text-based prompts to go to the gym may neglect important contextual barriers such as fitness deserts, cultural perspectives on exercise, or the prohibitive costs of gym membership that exclude certain populations.⁴⁹ Similarly, the unintended consequences of policy nudges can accidentally lead to undesirable systems-level outcomes, such as when bans on plastic shopping bags increased purchases of single-use plastic bags to collect trash or dispose of pet waste.⁵⁰

Choice Infrastructure

Where choice architecture focuses on discreet decision making moments, choice infrastructure works at the level of underlying structures, platforms, and processes that shape choice conditions, provide affordances for action and engagement, and allow behavioral solutions to operate effectively.⁵¹ Choice infrastructure can manifest in a range of physical and conceptual forms, from digital platforms such as electronic health records (EHR) to institutional policies like metrics for promotion, physical environments like private offices versus open-plan seating, or organizational hierarchies that create conduits for power and resources.

- of Economic Research, Cambridge, MA, 2021), 1–38, <https://doi.org/10.3386/w28499>.
- 51 Schmidt, "Model for Choice Infrastructure," 2.
-
- 52 Dan Lockton, "Architecture, Urbanism, Design and Behaviour: A Brief Review," *Architectures*, September 12, 2011, <https://architectures.danlockton.co.uk/2011/09/12/architecture-urbanism-design-and-behaviour-a-brief-review/>.
- 53 Marianne Bertrand, Sendhil Mullainathan, and Eldar Shafir, "Behavioral Economics and Marketing in Aid of Decision Making among the Poor," *Journal of Public Policy and Marketing* 25, no. 1 (2006): 14, <https://doi.org/10.1509/jppm.25.1.8>.
- 54 Betsy Otto et al., "Combating the Coronavirus without Clean Water," *World Resources Institute*, April 8, 2020, <https://www.wri.org/insights/combating-coronavirus-without-clean-water>.
- 55 Jamie F. Chriqui, Christina N. Sansone, and Lisa M. Powell, "The Sweetened Beverage Tax in Cook County, Illinois: Lessons from a Failed Effort," *American Journal of Public Health* 110, no. 7 (2020): 1009–16, <https://doi.org/10.2105/AJPH.2020.305640>.
- 56 Chris Lentino, "Preckwinkle Admits Soda Tax Was 'First and Foremost' about Revenue," *Illinois Policy*, October 5, 2017, <https://www.illinoispolicy.org/preckwinkle-admits-soda-tax-was-first-and-foremost-about-revenue/>.

Hence, choice infrastructure often contains embedded values that can benefit certain communities, values, and outcomes over others. Physical infrastructure in the form of hostile architecture, such as benches specifically designed to prevent homeless individuals from sleeping on them, explicitly installs a value system into the design of public space under the guise of public safety.⁵² Over time, infrastructural mechanisms can become normalized, such as in services that require payment by credit card or grant access to services uniquely via internet; ostensibly used to promote progress and efficiency, such enforcement through infrastructure can exert power by keeping certain populations—the underbanked or those with limited internet access—from full participation.⁵³

As a result, asymmetries in choice infrastructure can increase inequity, causing interventions that work in one context to fail elsewhere. For example, behavioral nudges aimed at increasing hygiene through frequent hand-washing have limited relevance for communities without reliable access to fresh running water.⁵⁴ In addition, even when policy is designed with equitable intent, the assumption that it imposes a roughly comparable burden and similar sets of benefits across target constituent groups is often questionable given limitations to access, frequency of use, and measurement norms.

Unlike choice architecture, which focuses on relatively low-cost interventions such as fine-tuning messaging or how options are presented, redesigning choice infrastructure can require significant investment and collaborative intent, and risks disrupting power dynamics. Designing at the unit of choice infrastructure therefore can pose a significant challenge. However, given that public health inequities are often deeply embedded within institutional systems structures, working at an infrastructural level can be necessary to root out and reconfigure imbalances of access.

Greater Than the Sum of Their Parts: Designing Conditions for Choice

While exploring choice posture, architecture, and infrastructure separately can surface valuable insights, they are also naturally intertwined. This suggests the value of exploring the triad's dynamics (Figure 2) in combination rather than as three individual nodes.

For example, in 2017, the city of Chicago introduced a regressive soda tax, in which a penny-per-ounce tax positioned as a public health measure was levied on sweetened beverages to solve an economic shortfall.⁵⁵ Given South Chicago's proximity to Indiana, however, consumers streamed across the border to purchase beverages at lower costs, leading to reduced, rather than increased, tax revenues. Thus, despite evidence-based incentives to drive new purchasing behaviors (choice architecture), the tax galvanized residual anger against local leadership associated with the tax while also increasing soda's agentic status (choice posture), the combination of which ultimately led to diminished support in the subsequent election cycle due to the perception that the tax was inequitable (choice infrastructure).⁵⁶

In a broader public health context, therefore, considering the dynamic relationships between choice architecture, posture, and infrastructure reinforces several important characteristics. First, it acknowledges the interrelated and nonlinear nature of public health behaviors, such as the influence of multiple

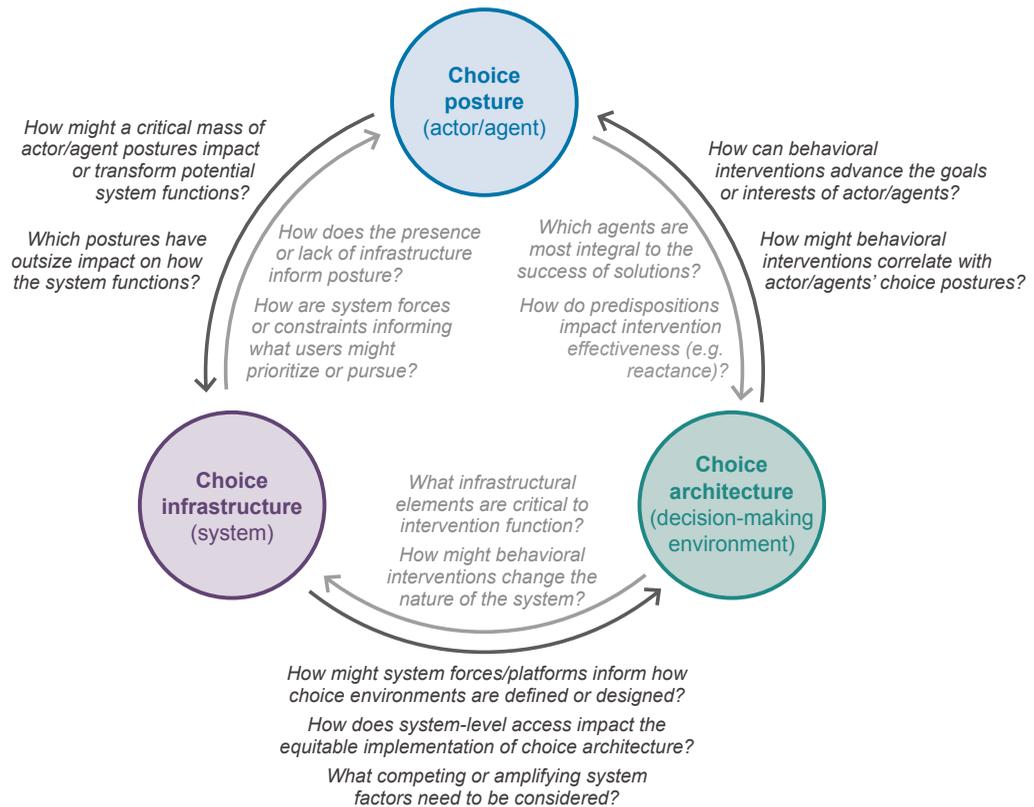


Figure 2
Dynamics and interactions between choice triad nodes, indicating relevant questions that might be addressed during problem solving. © 2022 Ruth Schmidt, Zeya Chen, and Veronica Paz Soldan.

concurrent public health interventions, the impact of community values and norms, and adaptations over time.⁵⁷ This reinforces that seemingly equivalent conditions may differ depending on one's posture toward public health interventions and the affordances of infrastructure. Perhaps more importantly, however, reframing choice conditions as the target of design activities decenters the burden of personal agency and responsibility, which too often places the onus on individuals to navigate flawed or inequitable systems.⁵⁸ Finally, the triad can be employed in different ways throughout the design process; as a diagnostic lens to identify current forces, conditions, and gaps; as a generative lens to help designers envision and craft improved solutions; and finally, in an evaluative mode to test the potential effectiveness of new approaches and identify where adjustments are necessary.

During the *diagnosis* phase of design, the triad can help practitioners understand the current state of affairs by noting agent postures and their impact; how options are positioned and perceived; how choice architecture shapes what is internalized, compared, and acted on; and how system infrastructure constrains or encourages equitable access. Employing a diagnostic lens can also illuminate which archetypical mental models are active, providing insight into the rules of the game that implicitly shape

57 Ruth Schmidt and Katelyn Stenger, "Behavioral Planning: Improving Behavioral Design with 'Roughly Right' Foresight," *Strategic Design Research Journal* 14, no. 1 (2021): 142, <https://doi.org/10.4013/sdrj.2021.141.12>.

58 Dulmini Perera, "Wicked Problems, Wicked Play: Fun Machines as Strategy," *FormAkademisk: Research Journal of Design and Design Education* 13, no. 2 (2020): article no. 1, <https://doi.org/10.7577/formakademisk.3378>.

- 59 Lawrence O. Gostin, "Politics and Public Health: The Flint Drinking Water Crisis," *Hastings Center Report* 46, no. 4 (2016): 5–6, <https://doi.org/10.1002/hast.598>; Sheela Nimishakavi, "The Long-Lasting Wages of Neglect: Flint Residents Plagued Again by Water Crisis," *Non-Profit Quarterly*, October 10, 2016, <https://nonprofitquarterly.org/long-lasting-wages-neglect-flint-residents-plagued-water-crisis/>.
- 60 K. Sabeel Rahman, "Constructing Citizenship: Exclusion and Inclusion Through the Governance of Basic Necessities," *Columbia Law Review* 118, no. 8 (2018): 2447–2503, <https://columbialawreview.org/content/constructing-citizenship-exclusion-and-inclusion-through-the-governance-of-basic-necessities/>.
- 61 Sarah Stillman, "Can Behavioral Science Help in Flint," *New Yorker*, January 17, 2017, <https://www.newyorker.com/magazine/2017/01/23/can-behavioral-science-help-in-flint>.

expectations or behaviors. During this phase, specific instances are gleaned from action situations and choice conditions are gathered, clustered, and abstracted, providing insight into what might need to be addressed or resolved at a more systemic level.

Practitioners can next employ the triad *generatively*, to inform potential solutions. In this mode, the model can be used to speculate on how to make solutions responsive to current postures, values, and narratives, or illuminate how they might need to be positioned to shape new stances; encourage or discourage target behaviors with improved choice architecture; and indicate how infrastructural elements might be leveraged or reconfigured to create supportive choice conditions. Here, the abstracted principles gained during diagnosis are given concrete shape in the form of specific proposals and new interventions.

Finally, the triad can be used as an *evaluative* lens to gauge the effectiveness of newly designed choice conditions, by assessing how choice postures may have changed as a result of solutions; to assess the extent to which behavioral interventions lead to the adoption of behaviors in the interest of public health; and to understand how infrastructures support or generate the production of new kinds of value. Here, evidence and feedback from specific contextualized solutions is captured and abstracted into principles that help practitioners recognize where course-correction may be necessary (Figure 3).

Applications to Public Health Policy: The Flint Water Crisis and Covid-19 Pandemic

To indicate how the triad might be used in the context of public health challenges, we discuss below how these lenses apply to two very different public health crises: the 2014 Flint, Michigan water crisis and the US response to the Covid-19 pandemic. Where in the former case we employ the triad mainly in the interest of retrospective analysis, in the latter we suggest how the triad might also be used to generate new choice conditions.

The Flint Water Crisis: Diagnosing Public Health Conditions

In 2014, what began as a straightforward rerouting of Flint, Michigan's municipal water supply as a cost-containment strategy escalated into a public health emergency when the switch introduced contaminated water into thousands of community households, many home to low-income African Americans.⁵⁹ The chronic exposure to contaminants directly impacted residents' physical and cognitive health as well as contributing to ancillary effects, such as youth learning difficulties.⁶⁰ In 2017, the newly formed US Government Social and Behavioral Sciences Team (SBST) was engaged to address Flint's fraught situation in partnership with the US Environmental Protection Agency (EPA).⁶¹ Despite a data-driven approach and insights gleaned from interviews with community members, SBST's choice architecture solutions and behavioral prompts to encourage the use of water filters and bottled water to reduce ingesting contaminants had lackluster uptake.

As a diagnostic case, the health crisis in Flint presents a trifecta of inequitable choice infrastructure, well-intentioned but only partially successful attempts to implement choice architecture, and a range of postural

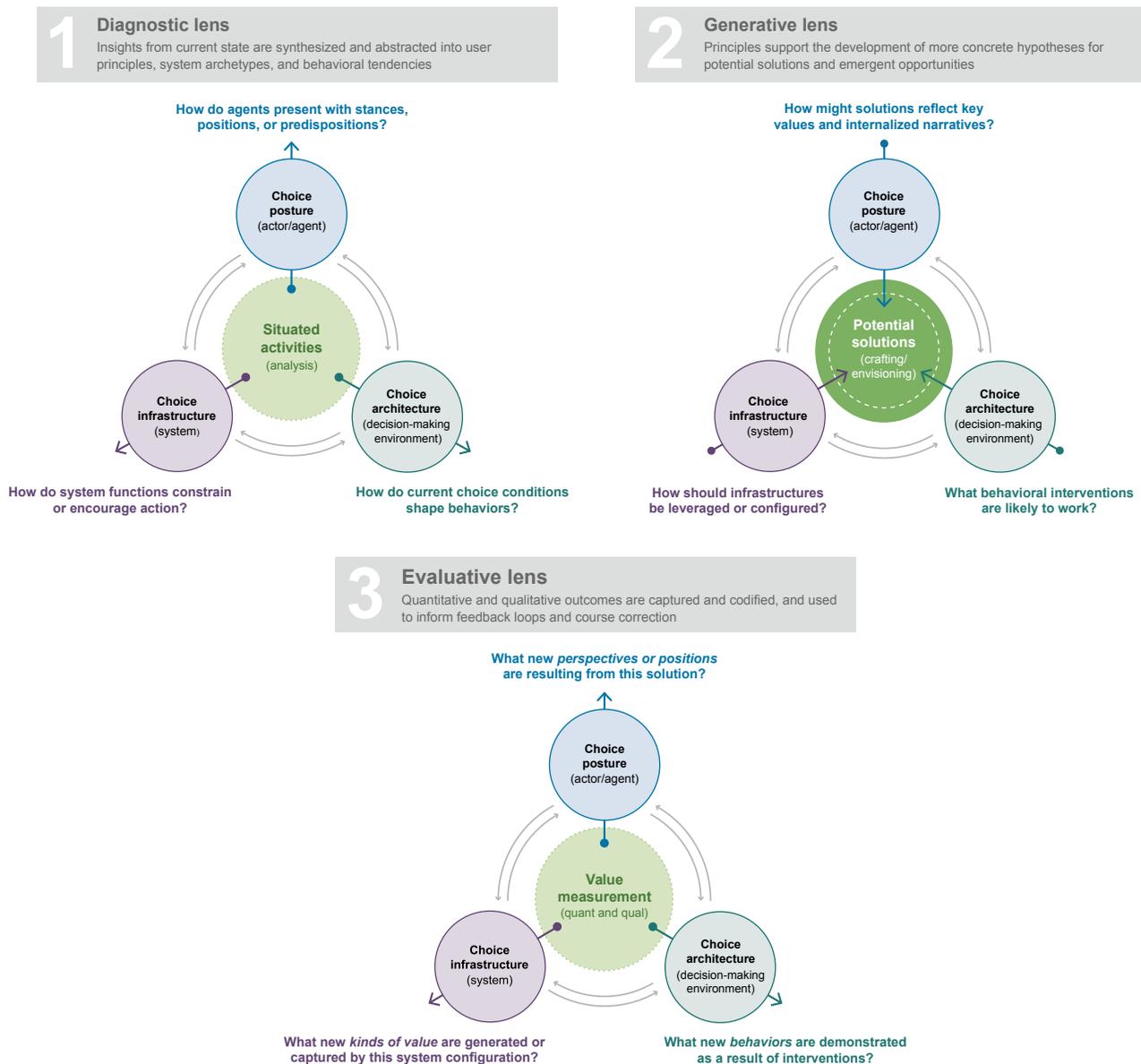


Figure 3
Diagnostic, generative, and evaluative lenses. © 2022 Ruth Schmidt, Zeya Chen, and Veronica Paz Soldan.

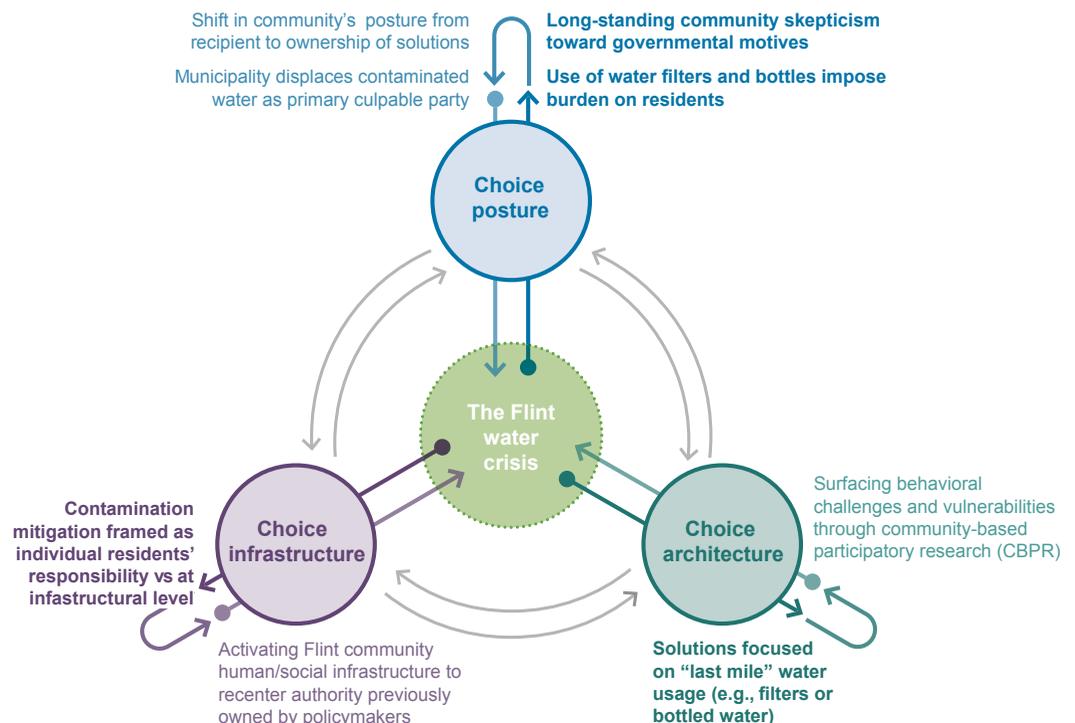
62 Nadia Gaber, "Mobilizing Health Metrics for the Human Right to Water in Flint and Detroit, Michigan," *Health and Human Rights* 21, no. 1 (2019): 179–89, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6586960/>.

complexities.⁶² Adopting the triad lens, therefore, can provide new insight into the nature of the problem and what a successful approach might have looked like.⁶³

Where the need to mitigate contamination may have initially presented as a straightforward habit formation challenge, framing it purely in terms of choice architecture and behavioral change neglected important postural and infrastructural components of the situation. From a postural standpoint, while the SBST team's approach recognized the community's distrust of the government's motives and services, fed by a long history of resource scarcity

- 63 Nimishakavi, "Long-Lasting Wages of Neglect," 15; Rahman, "Constructing Citizenship," 2502.
- 64 Anna Maria Barry-Jester, "What Went Wrong in Flint?," *Five Thirty Eight*, January 26, 2016, <https://fivethirtyeight.com/features/what-went-wrong-in-flint-water-crisis-michigan/>; Rahman, "Constructing Citizenship," 2448.
- 65 Gaber, "Mobilizing Health Metrics," 182; Joram Feitsma and Mark Whitehead, "Bounded Interdisciplinarity: Critical Interdisciplinary Perspectives on Context and Evidence in Behavioural Public Policies," *Behavioural Public Policy* 6, no. 3 (2019): 358–84, <https://doi.org/10.1017/bpp.2019.30>.
- 66 Kees Dorst, "The Core of 'Design Thinking' and Its Application," *Design Studies* 32, no. 6 (2011): 521–32, <https://doi.org/10.1016/j.destud.2011.07.006>; Bason, *Design for Policy*; Van Buuren et al., "Improving Public Policy," 5.

Figure 4
Application of the choice triad in the context of Flint, Michigan's water crisis. © 2022 Ruth Schmidt, Zeya Chen, and Veronica Paz Soldan.



and economic disparity, solutions also placed the onus of responsibility firmly on families and individuals, essentially putting them in the position of adapting to a broken system rather than focusing on how to fix the system itself. In addition, these solutions positioned the water bottles and filters as heroic rather than as impositions that placed an added economic and behavioral burden on residents. Alternatively, reframing the issue as a narrative of poisoned water might have emphasized both the shared sense of agency and the *infrastructural* nature of the challenge, worthy of demanding redress at the community or municipality level rather than at the level of individuals (Figure 4).

The intertwined nature of choice posture, architecture, and infrastructure was also reflected in subsequent efforts to measure and evaluate the nature of the contamination. After the official water contamination report provided by the Michigan Department of Environmental Quality (MDEQ) was found to have intentionally cloaked the severity of the issue,⁶⁴ the report's disingenuous posture sparked skepticism that *any* alternative findings might be equally suspect.⁶⁵ All this is an excellent illustration of the interplay of triad nodes: by calling measurement norms and the nature of which evidence counts into question, the data posture not only shaped how meaning was constructed, where power sat, and whose story dictated the narrative, but also demonstrated how extreme postures can destabilize choice infrastructure. This example also serves as a stark reminder that policy is fundamentally subjective, agentic, and adaptive, despite the best intentions of policy designers.⁶⁶

More positively, however, another example from the Flint context highlights how components of the choice triad can align in beneficial ways, and how

67 Gaber, "Mobilizing Health Metrics," 184.

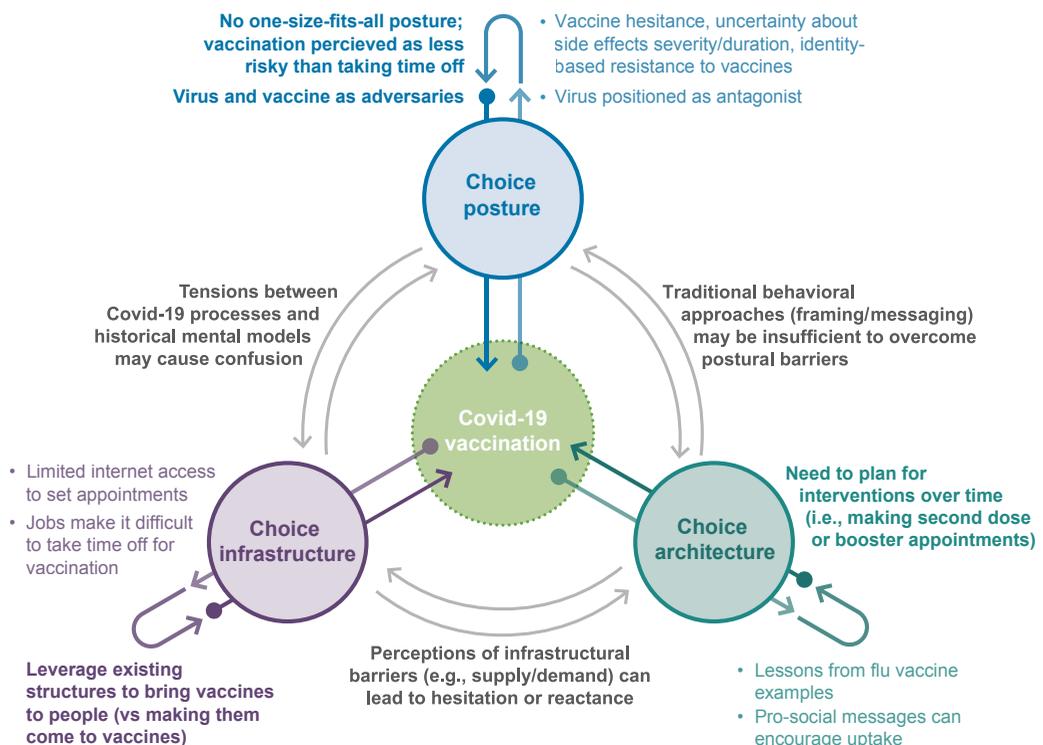
infrastructural changes can shape postures. In this case, Flint community members embraced community-based participatory research, adopting citizen science practices to expose health and community vulnerabilities that had previously been underrepresented.⁶⁷ In doing so, the community activated a social form of choice infrastructure, recentring the authority historically held by policymakers back within the community. In addition to highlighting how power is frequently scripted directly into traditional structures, this act of self-advocacy and infrastructural reengineering upended traditional notions of expertise and evidence, and established a newfound sense of ownership that was lacking in the community's choice posture.

Vaccination and the Covid-19 Pandemic: Choice Conditions and Equity

The United States' public health efforts to encourage vaccination against Covid-19, in contrast, provide insight into more generative applications of the triad, indicating how the model might be used to construct solutions as well as deconstruct current states (Figure 5).

From a behavioral choice architecture perspective, efforts to encourage yearly flu vaccinations are often stymied by several well-known behavioral barriers: the benefits are abstract, the annual cadence makes habit-formation techniques impractical, and the effort to make and keep an appointment to get vaccinated is typically spent on more urgent tasks. In these cases, choice architecture interventions tend to focus on a combination of informational

Figure 5
Application of the choice triad in the context of Covid-19 vaccination efforts. © 2022 Ruth Schmidt, Zeya Chen, and Veronica Paz Soldan.



- 68 Jay J. van Bavel et al., "Using Social and Behavioural Science to Support COVID-19 Pandemic Response," *Nature Human Behaviour* 4, no. 5 (2020): 460–71, <https://doi.org/10.1038/s41562-020-0884-z>.
- 69 Sarah Toy, "Why Some Healthcare Workers Would Rather Lose Their Jobs Than Get Vaccinated," *Wall Street Journal*, October 22, 2021, <https://www.wsj.com/articles/covid-19-vaccinations-healthcare-workers-refuse-risk-jobs-11634915929>.
- 70 Samantha Artiga and Liz Hamel, "How Employer Actions Could Facilitate Equity in COVID-19 Vaccinations," *Kaiser Family Foundation*, May 17, 2021, <https://www.kff.org/policy-watch/how-employer-actions-could-facilitate-equity-in-covid-19-vaccinations/>.
- 71 Schmidt, "Model for Choice Infrastructure," 14.

tactics. These can include message framing, reminders, and information about site availability; prosocial and peer pressure nudges; and reducing administrative burden to make vaccinations as easy as possible to get.⁶⁸

Nevertheless, the public health case for Covid-19 vaccination in the United States was confronted by considerable postural tension. Despite lessons learned from nudges designed to encourage flu vaccination, initial behavioral strategies to encourage Covid-19 jabs also had to combat strong anti-vax choice postures and psychological reactance to vaccination. While vaccine-hesitant audiences derived benefit from prompts framing vaccination as safe, efficient, and prosocial, for example, and which focused on where, when, and how to receive a shot—the same approaches were met with resistance by those with naturally suspicious postures, including some clinicians.⁶⁹ One hypothesis that accounts for this pushback (grounded in the wider context of the anti-vax movement) suggests that the vaccine's posture as a stealth agent presented an insurmountable narrative; more broadly, it indicates that tensions created by adversarial postures present a considerable challenge to public health policy, and reinforces the need to design choice architecture that avoids taking a one-size-fits-all approach.

Early US Covid vaccination processes also faced additional infrastructural challenges compared to typical flu vaccine contexts, resulting in two distinct but equally important effects. First, not only did receiving the Covid-19 vaccination require new processes—ranging from scheduling appointments to collecting documentation to recovery from side effects—but it also conflicted with existing conceptual and infrastructural archetypes modeled on prior flu shot experiences. This tension between existing and new mental models muddied the already complex choice conditions, amplifying uncertainties that heightened concerns and fears. In the future, emphasizing infrastructural parallels to flu vaccinations, when possible, and making deviations from the known more evident may help policymakers design choice conditions that work with incoming perceptions and mental models—rather than against them.

Second, the Covid-19 case also highlights the need to deliberately design equity into choice infrastructure. Positioning digital platforms as the primary means of access to vaccination services presumed that access to be equally distributed and reliable, ignoring inequities in choice infrastructure. However, infrastructural asymmetries can take a variety of forms, as indicated by studies that employer policies discouraging employees from taking time off for the shot and side effect management contributed more to lagging immunization rates than vaccine hesitancy in certain populations.⁷⁰ The effective design of choice conditions therefore requires being attentive to potential postural, architectural, and infrastructural limitations as much as proposed functionality, especially when designing across a variety of individuals and populations.⁷¹

As with the Flint case, changes in choice conditions also reveal new opportunities. The widespread shift to remote healthcare during the pandemic required new habit formation (choice architecture). There was also the matter of overcoming clinician and recipient skepticism about healthcare delivery (choice posture). At the same time, platforms like Zoom reshaped communication and engagement models (choice infrastructure), while in parallel,

- 72 Susan Leigh Star and James R. Griesemer, "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39," *Social Studies of Science* 19, no. 3 (1989): 387–420, <http://www.jstor.org/stable/285080>.
- 73 Dorst, "Core of 'Design Thinking,'" 524.
- 74 Whitney and Nogueira, "Cutting Cubes Out of Fog," 131.
- 75 Michie et al. "Behaviour Change Wheel," 2.
- 76 Schmidt, "Model for Choice Infrastructure," 8.
- 77 Bason, *Design for Policy*; Ruth Schmidt, "Strange Bedfellows: Design Research and Behavioral Design," in *Co-creation*, vol. 3 of *Proceedings of DRS 2020 International Conference*, ed. Stella Boess, Ming Cheung, and Rebecca Cain (London: Design Research Society, 2020), 1455, <https://doi.org/10.21606/drs.2020.252>.
- 78 Donald A. Norman, *The Design of Everyday Things*, rev. and expanded ed. (New York: Basic Books, 2013).
- 79 Claus-Christian Carbon, "Psychology of Design," *Design Science* 5 (2019): e26, <https://doi.org/10.1017/dsj.2019.25>.
- 80 Ruth Schmidt and Katelyn Stenger, "Overcoming Bounded Scalability: Achieving Interoperability through Behavioral Boundary Objects," in *Advances in Creativity, Innovation, Entrepreneurship and Communication of Design, Proceedings of the AHFE 2021, Lecture Notes in Networks and Systems*, vol. 276, ed. Evangelos Markopoulos et al. (Cham: Springer, 2021), 8, https://doi.org/10.1007/978-3-030-80094-9_1.

policy that had previously not allowed telehealth visits to be compensated through insurance made this new engagement model economically viable (choice infrastructure). Although some systems are showing signs of retreating from this expansion in compensation models, the emergence of telehealth as a viable channel, even temporarily, signals the possibility of establishing new and more equitable choice conditions in the interest of both individual and system health.

Implications and Questions for Further Exploration

All fields have their own disciplinary norms and processes, and any attempt to integrate disciplines will face challenges related to methodological alignment. Ostensibly simple terms like "research" signify wildly different concepts and outputs across disciplines, and so special attention must be paid to the methodological approaches used for cross-disciplinary collaboration. This translates into the use of methodological tools, such as boundary objects,⁷² and interpersonal approaches that cultivate respect, trust, and a keen articulation of the value of diverse approaches.⁷³

However, a new model does not necessarily mean new tools. Echoing the portfolio approach of the Whole View model,⁷⁴ the choice triad model could draw on proven and familiar design frameworks (e.g., journey maps and POEMS) and behavioral tools (e.g., the COM-B framework⁷⁵ and SPACE framework for choice infrastructure⁷⁶) to inform policy framing and solution development. Using familiar tools in new ways may even yield surprising new benefits. For example, employing a user journey to inform the development of choice architecture adds an experiential lens that a behavioral approach might otherwise lack. The use of mixed methods approaches can also reduce practitioners' tendencies to prioritize one discipline at the expense of others, and combine the confidence supplied data-driven approaches with an open-mindedness to a more expansive set of possible solutions.⁷⁷

Considering design through the lenses of behavioral science's antecedents—psychology and economics—may also impact the future of behavioral design and behavioral public policy. Donald Norman's *The Design of Everyday Things* is well known for popularizing the notion of affordances,⁷⁸ which directly influenced early notions of behavioral economics. However, and despite more recent inclusion in policy design conversations in the form of behavioral science and nudging, a deeper bed of empirical insight into how individuals perceive options and make judgments in more complex contexts is curiously lacking. For example, the design literature is rife with psychological insights focusing on respondents' responses to a product's physical (design and branding) characteristics.⁷⁹ Such insights are used to evaluate consumer readiness to buy, rather than clarifying broader perspectives on choice and behavior, particularly within complex systems. This presents a clear gap in knowledge, and an opportunity to more systematically codify and express design patterns and a syntax for problem solving in the context of policy- and systems-level behavioral challenges.⁸⁰

Similarly, business strategy has been grappling with the economics of design for decades, in the conspicuous absence of design-based theory

- 81 Patrick Whitney, "Design and the Economy of Choice," *She Ji: The Journal of Design, Economics, and Innovation* 1, no. 1 (2015): 60, <https://doi.org/10.1016/j.sheji.2015.09.001>.
- 82 Civilla, "Small Changes, Big Impact," Civilla, accessed 15 July, 2022, <https://civilla.org/stories/small-changes-big-impact>.
- 83 Jung-Jo Lee, "Frame Failures and Re-framing Dialogues in the Public Sector Design Projects," *International Journal of Design* 14, no. 1 (2020): 82, <http://www.ijdesign.org/index.php/IJDesign/article/view/3717/894>.

based on a broader conception of economics as exchange. Filling this gap will help designers better understand the psychological mechanisms at work when consumers navigate decision making tradeoffs under conditions of complexity and uncertainty. How do embedded stances or preconceptions impact how choices are weighed against each other? How do environmental conditions and infrastructural plumbing inform judgments, decision making, and behavior about what counts as a viable choice?

Embedding the results of psychological and economic inquiry more deeply in design practice would be a useful expansion of the field's longstanding embrace of certain social sciences, including ethnography and anthropology. It also suggests potential opportunities to elaborate on existing economies of choice,⁸¹ expanding from a focus on production and consumption (what should we make? who is it for? why will it create value? how should we make it?) to informing broader principles for civic and cultural exchange. To do so may require the development of new methods that help to clarify a) which underlying conditions can create the right environment for effective decision-making and choice; b) the ways an understanding of postures can suggest which interventions are more likely to be successful; and c) the characteristics infrastructures must have to deliver equitable access and value. This integration of perspectives suggests a need to build adaptation and evolution into these design approaches, expanding upon what has worked while also considering what's next.

Finally, the limitations of design and behavior are worth considering, in or outside of public health. While interventions that redesign non-human agent postures do yield significant and incontrovertible benefit, the degree to which incoming human postures can be shaped by behavioral interventions is generally more limited. It is true that making a form simpler and shorter—approachable, unthreatening—can increase the number and accuracy of completions.⁸² Nevertheless, it is impossible to actively design a love for rom-coms, or the squeamishness that comes from the prospect of public speaking. As a result, any attempt to redesign external environments and plumbing (via choice architecture and infrastructure, respectively), or revise the posture of non-human agents, may call for a different strategy than calling for humans to shift their mindsets. This challenge is familiar to policy designers who have had to navigate resistance to design processes that conflict with policymakers' existing mental models and postures. At other times, tensions arise when policymakers encounter new modes of inquiry and forms of evidence, struggle to overcome a tendency towards risk avoidance, or express concern about usurping authority.⁸³ In these cases, building confidence and shifting mindsets is rarely a quick fix; it comes about through continual and deliberate engagement that requires trust, collaboration, and a sense of partnership.

Conclusion

While strategic and human-centered design methods, system design, and nudges in the form of behavioral public policy are all respected contributors to public health policy, they have traditionally occupied separate pedagogical and disciplinary spheres of influence. However, as seen in varied contexts

- 84 Langdon Winner, "Do Artifacts Have Politics?" in *Computer Ethics*, 2nd ed., ed. John Weckert (London: Routledge, 2017), 178.
- 85 Ronald C. Arnett and Pat Arneson, *Dialogic Civility in a Cynical Age: Community, Hope, and Interpersonal Relationships* (Albany, NY: State University of New York Press, 1999).
- 86 Daniel J. Huppertz, "Revisiting Herbert Simon's 'Science of Design,'" *Design Issues* 31, no. 2 (2015): 37, https://doi.org/10.1162/DESI_a_00320; B. Guy Peters and Nenad Rava, "Policy Design: From Technocracy to Complexity, and Beyond," in *Proceedings of IPPA International Public Policy Conference* (Singapore, June 28–30, 2017), 1–23, <https://www.ippapublicpolicy.org/file/paper/5932fa23369d0.pdf>.

such as Flint's water crisis and in Covid-19 pandemic responses, the quest for effective and efficient policy may not come down to which one of these approaches is best, but how to best integrate them. We suggest that a choice triad model that integrates dimensions of choice posture, choice architecture, and choice infrastructure might work if used in tandem to reframe and recenter the locus of problem solving, leading to improved conditions for equitable and effective choice.

However, no process, framework, or methodology is neutral.⁸⁴ every process, designer, framework, and solution comes with bias. Even methodologies that are scientific and objective (such as behavioral science), openly participatory (as design strives to be), or holistic in their goals (in the form of systems design) are shaped by ideologies that promote certain ends and beliefs over others. It would be foolish to position the triad as exempt. The value of the choice triad may therefore lie not in its ability to agnostically eradicate system dysfunction, but as a form of dialogic that can help transdisciplinary teams identify interrelated tensions or potential blind spots. Its purpose, therefore, may be to prompt conversation about how and where to focus those efforts, forcing practitioners to continually engage with others who represent alternative viewpoints, and position design as a continual process of exchange rather than a process free of politics.⁸⁵

Finally, do not construe our focus exclusively on public health here as a statement about the triad's broader applicability. Rather, consider the model as a strategic approach to complex systems challenges that require simultaneously designing for behavior at the individual and population levels. One thing we can be certain of is this: contemporary policy design conditions will continue to change. The need to adapt extends to designing choice conditions as an activity focused on iterating *re*-solutions,⁸⁶ rather than developing solutions. This reflects the understanding that, because conditions are themselves continually in flux, solutions—and practitioners—must both become adaptable as well.

Declaration of Interests

There are no conflicts of interest involved in this article.

References

- Arnett, Ronald C., and Pat Arneson. *Dialogic Civility in a Cynical Age: Community, Hope, and Interpersonal Relationships*. Albany, NY: State University of New York Press, 1999.
- Artiga, Samantha, and Liz Hamel. "How Employer Actions Could Facilitate Equity in COVID-19 Vaccinations." *Kaiser Family Foundation*, May 17, 2021. <https://www.kff.org/policy-watch/how-employer-actions-could-facilitate-equity-in-covid-19-vaccinations/>.
- Banerjee, Pronobesh, Promothesh Chatterjee, Sanjay Mishra, and Anubhav A. Mishra. "Loss Is a Loss, Why Categorize It? Mental Accounting Across Cultures." *Journal of Consumer Behaviour* 18, no. 2 (2019): 77–88. <https://doi.org/10.1002/cb.1748>.
- Banerjee, Sanchayan, and Peter John. "Nudge Plus: Incorporating Reflection into Behavioral Public Policy." *Behavioural Public Policy* (2020): 1–16. <https://doi.org/10.1017/bpp.2021.6>.
- Barry-Jester, Anna Maria. "What Went Wrong in Flint?" *Five Thirty Eight*, January 26, 2016. <https://fivethirtyeight.com/features/what-went-wrong-in-flint-water-crisis-michigan/>.

- Barry, Andrew, Georgina Born, and Gisa Weszkalnys. "Logics of Interdisciplinarity." *Economy and Society* 37, no. 1 (2008): 20–49. <https://doi.org/10.1080/03085140701760841>.
- Bason, Christian. *Design for Policy*. New York: Routledge, 2016.
- Bates, Mary Ann, and Rachel Glennerster. "The Generalizability Puzzle." *Stanford Social Innovation Review* 3 (2017): 50–54. <https://doi.org/10.48558/eyy5-3s89>.
- Bateson, Regina. "Strategic Discrimination." *Perspectives on Politics* 18, no. 4 (2020): 1068–87. <https://doi.org/10.1017/S153759272000242X>.
- Van Bavel, Jay J., Katherine Baicker, Paulo S. Boggio, Valerio Capraro, Aleksandra Cichocka, Mina Cikara, Molly J. Crockett et al. "Using Social and Behavioural Science to Support COVID-19 Pandemic Response." *Nature Human Behaviour* 4, no. 5 (2020): 460–71. <https://doi.org/10.1038/s41562-020-0884-z>.
- Bazzano, Alessandra N., Jane Martin, Elaine Hicks, Maille Faughnan, and Laura Murphy. "Human-Centred Design in Global Health: A Scoping Review of Applications and Contexts." *PLoS One* 12, no. 11 (2017): e0186744. <https://doi.org/10.1371/journal.pone.0186744>.
- Bertrand, Marianne, Sendhil Mullainathan, and Eldar Shafir. "Behavioral Economics and Marketing in Aid of Decision Making among the Poor." *Journal of Public Policy and Marketing* 25, no. 1 (2006): 8–23. <https://doi.org/10.1509/jppm.25.1.8>.
- Bicchieri, Cristina. "Norms, Conventions, and the Power of Expectations." In *Philosophy of Social Science: A New Introduction*, edited by Nancy Cartwright and Eleonora Montuschi, 208–29. Oxford: Oxford University Press, 2014. <https://repository.upenn.edu/belab/1/>.
- Van der Bijl-Brouwer, Mieke. "Designing for Social Infrastructures in Complex Service Systems: A Human-Centered and Social Systems Perspective on Service Design." *She Ji: The Journal of Design, Economics, and Innovation* 3, no. 3 (2017): 183–97. <https://doi.org/10.1016/j.sheji.2017.11.002>.
- Blomkamp, Emma. "The Promise of Co-design for Public Policy." *Australian Journal of Public Administration* 77, no. 4 (2018): 729–43. <https://doi.org/10.1111/1467-8500.12310>.
- Bradley, Declan Terence, Mariam Abdulmonem Mansouri, Frank Kee, and Leandro Martin Totaro Garcia. "A Systems Approach to Preventing and Responding to COVID-19." *EclinicalMedicine* 21 (April 2020): article no. 100325. <https://doi.org/10.1016/j.eclinm.2020.100325>.
- Vom Brocke, Jan, Wil van der Aalst, Thomas Grisold, Waldemar Kremser, Jan Mendling, Brian Pentland, Jan Recker, Maximilian Roeglinger, Michael Rosemann, and Barbara Weber. "Process Science: The Interdisciplinary Study of Continuous Change." Working paper, posted by SSRN, September 7, 2021. <https://doi.org/10.2139/ssrn.3916817>.
- Buchanan, Richard. "Design Research and the New Learning." *Design Issues* 17, no. 4 (2001): 3–23. <https://doi.org/10.1162/07479360152681056>.
- Buchanan, Richard. "Systems Thinking and Design Thinking: The Search for Principles in the World We Are Making." *She Ji: The Journal of Design Economics and Innovation* 5, no. 2 (2019): 85–104. <https://doi.org/10.1016/j.sheji.2019.04.001>.
- Van Buuren, Arwin, Jenny M. Lewis, B. Guy Peters, and William Voorberg. "Improving Public Policy and Administration: Exploring the Potential of Design." *Policy and Politics* 48, no. 1 (2020): 3–19. <https://doi.org/10.1332/030557319X15579230420063>.
- Carbon, Claus-Christian. "Psychology of Design." *Design Science* 5 (2019): e26. <https://doi.org/10.1017/dsj.2019.25>.
- Carmichael, Ted, and Mirsad Hadžikadić. "The Fundamentals of Complex Adaptive Systems." In *Complex Adaptive Systems: Views from the Physical, Natural, and Social Sciences*, edited by Ted Carmichael, Andrew J. Collins, and Mirsad Hadžikadić, 1–16. Cham: Springer, 2019.
- Cash, Philip, Pramod Khadilkar, Joanna Jensen, Camilla Dusterdich, and Ruth Muggé. "Designing Behaviour Change: A Behavioural Problem/Solution (BPS) Matrix." *International Journal of Design* 14, no. 2 (2020): 65–83. <http://www.ijdesign.org/index.php/IJDesign/article/view/3952>.

- Ceschin, Fabrizio, and İdil Gaziulusoy. *Design for Sustainability: A Multi-level Framework from Products to Socio-technical Systems*. Oxford: Routledge, 2019. <https://doi.org/10.4324/9780429456510>.
- Chriqui, Jamie F., Christina N. Sansone, and Lisa M. Powell. "The Sweetened Beverage Tax in Cook County, Illinois: Lessons from a Failed Effort." *American Journal of Public Health* 110, no. 7 (2020): 1009–16. <https://doi.org/10.2105/AJPH.2020.305640>.
- Clair, Judith A., Beth K. Humberd, Heather M. Caruso, and Laura Morgan Roberts. "Marginal Memberships: Psychological Effects of Identity Ambiguity on Professionals Who Are Demographically Different from the Majority." *Organizational Psychology Review* 2, no. 1 (2012): 71–93. <https://doi.org/10.1177/2041386611429041>.
- Dorst, Kees. "The Core of 'Design Thinking' and Its Application." *Design Studies* 32, no. 6 (2011): 521–32. <https://doi.org/10.1016/j.destud.2011.07.006>.
- Einfeld, Colette, and Emma Blomkamp. "Nudge and Co-design: Complementary or Contradictory Approaches to Policy Innovation?" *Policy Studies* 43, no. 5 (2021): 901–19. <https://doi.org/10.1080/01442872.2021.1879036>.
- Ewert, Benjamin. "Moving beyond the Obsession with Nudging Individual Behaviour: Towards a Broader Understanding of Behavioural Public Policy." *Public Policy and Administration* 35, no. 3 (2020): 337–60. <https://doi.org/10.1177/0952076719889090>.
- Feitsma, Joram, and Mark Whitehead. "Bounded Interdisciplinarity: Critical Interdisciplinary Perspectives on Context and Evidence in Behavioural Public Policies." *Behavioural Public Policy* 6, no. 3 (2019): 358–84. <https://doi.org/10.1017/bpp.2019.30>.
- Forberger, Sarah, L. Reisch, T. Kampfmann, and H. Zeeb. "Nudging to Move: A Scoping Review of the Use of Choice Architecture Interventions to Promote Physical Activity in the General Population." *International Journal of Behavioral Nutrition and Physical Activity* 16, no. 1 (2019): article no. 77. <https://doi.org/10.1186/s12966-019-0844-z>.
- Forlano, Laura. "Posthumanism and Design." *She Ji: The Journal of Design, Economics, and Innovation* 3, no. 1 (2017): 16–29. <https://doi.org/10.1016/j.sheji.2017.08.001>.
- Gaber, Nadia. "Mobilizing Health Metrics for the Human Right to Water in Flint and Detroit, Michigan." *Health and Human Rights* 21, no. 1 (2019): 179–89. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6586960/>.
- Glanz, Karen, and Donald B. Bishop. "The Role of Behavioral Science Theory in Development and Implementation of Public Health Interventions." *Annual Review of Public Health* 31 (2010): 399–418. <https://doi.org/10.1146/annurev.publhealth.012809.103604>.
- Gostin, Lawrence O. "Politics and Public Health: The Flint Drinking Water Crisis." *Hastings Center Report* 46, no. 4 (2016): 5–6. <https://doi.org/10.1002/hast.598>.
- Greenhalgh, Trisha. "Will COVID-19 Be Evidence-Based Medicine's Nemesis?" *PLoS Medicine* 17, no. 6 (2020): e1003266. <https://doi.org/10.1371/journal.pmed.1003266>.
- Halpern, David, and Michael Sanders. "Nudging by Government: Progress, Impact, & Lessons Learned." *Behavioral Science & Policy* 2, no. 2 (2006): 53–65. Available at <https://behavioralpolicy.org/wp-content/uploads/2017/06/Sanders-web.pdf>.
- Hauser, Oliver P., Francesca Gino, and Michael I. Norton. "Budging Beliefs, Nudging Behaviour." *Mind & Society* 17, no. 1 (2018): 15–26. <https://doi.org/10.1007/s11299-019-00200-9>.
- Hollands, Gareth J., Ian Shemilt, Theresa M. Marteau, Susan A. Jebb, Michael P. Kelly, Ryota Nakamura, Marc Suhrcke, and David Ogilvie. "Altering Choice Architecture to Change Population Health Behaviour: A Large-Scale Conceptual and Empirical Scoping Review of Interventions Within Micro-environments." Report, published by University of Cambridge, 2013. <https://www.repository.cam.ac.uk/handle/1810/245108>.

- Homonoff, Tatiana, Lee-Sien Kao, Javiera Selman, Christina Seybolt. "Skipping the Bag: The Intended and Unintended Consequences of Disposable Bag Regulation." Working paper 28499, National Bureau of Economic Research, Cambridge, MA, 2021. <https://doi.org/10.3386/w28499>.
- Howlett, Michael. "Challenges in Applying Design Thinking to Public Policy: Dealing with the Varieties of Policy Formulation and Their Vicissitudes." *Policy & Politics* 48, no. 1 (2020): 49–65. <https://doi.org/10.1332/030557319X15613699681219>.
- Huppatz, Daniel J. "Revisiting Herbert Simon's 'Science of Design.'" *Design Issues* 31, no. 2 (2015): 29–40. https://doi.org/10.1162/DESI_a_00320.
- Kimbell, Lucy. "Design in the Time of Policy Problems." In *Proceedings of DRS 2016: Design Research Society 50th Anniversary Conference*, 1–14. Brighton, UK, June 27–30, 2016. <https://www.drs2016.org/498>.
- Kohl, Harold W, Cora Lynn Craig, Estelle Victoria Lambert, Shigeru Inoue, Jasem Ramadan Alkandari, Grit Leetongin, Sonja Kahlmeier, for the Lancet Physical Activity Series Working Group. "The Pandemic of Physical Inactivity: Global Action for Public Health." *Lancet* 380, no. 9838 (2012): 294–305. [https://doi.org/10.1016/S0140-6736\(12\)60898-8](https://doi.org/10.1016/S0140-6736(12)60898-8).
- Lambe, Fiona, Ylva Ran, Marie Jürisoo, Stefan Holmlid, Cassilde Muhoza, Oliver Johnson, and Matthew Osborne. "Embracing Complexity: A Transdisciplinary Conceptual Framework for Understanding Behavior Change in the Context of Development-Focused Interventions." *World Development* 126 (February 2020): article no. 104703. <https://doi.org/10.1016/j.worlddev.2019.104703>.
- Latour, Bruno. "Where are the Missing Masses? A Sociology of Few Mundane Objects." In *Shaping Technology/Building Society: Studies in Sociotechnical Change*, edited by Wiebe E. Bijker and John Law, 225–58. Cambridge, MA: MIT Press, 1992. https://www.open.edu/openlearn/pluginfile.php/877054/mod_resource/content/3/dd308_1_missing_masses.pdf.
- Lawrence, Roderick J., and Carole Després. "Futures of Transdisciplinarity." *Futures* 36, no. 4 (2004): 397–405. <https://doi.org/10.1016/j.futures.2003.10.005>.
- Lee, Jung-Jo. "Frame Failures and Reframing Dialogues in the Public Sector Design Projects." *International Journal of Design* 14, no. 1 (2020): 81–94. <http://www.ijdesign.org/index.php/IJDesign/article/view/3717/894>.
- Lentino, Chris. "Preckwinkle Admits Soda Tax Was 'First and Foremost' about Revenue." *Illinois Policy*, October 5, 2017. <https://www.illinoispolicy.org/preckwinkle-admits-soda-tax-was-first-and-foremost-about-revenue/>.
- Lockton, Dan. "Architecture, Urbanism, Design and Behaviour: A Brief Review." *Architectures*, September 12, 2011. <https://architectures.danlockton.co.uk/2011/09/12/architecture-urbanism-design-and-behaviour-a-brief-review/>.
- Malcolm, Bridget, and Mieke van der Bijl-Brouwer. "Developing a Systemic Design Practice to Support a Regulatory Agency in Addressing Complex Problems." In *Proceedings of RSD5 Symposium*, Toronto, 2016. Available at <https://www.academia.edu/34793799/>.
- Marteau, Theresa M., Paul C. Fletcher, Marcus R. Munafò, and Gareth J. Hollands. "Beyond Choice Architecture: Advancing the Science of Changing Behaviour at Scale." *BMC Public Health* 21, no. 1 (2021): article no. 1531. <https://doi.org/10.1186/s12889-021-11382-8>.
- Meadows, Donella H. *Leverage Points: Places to Intervene in a System*. North Charleston, SC: Sustainability Institute, 1999.
- Melles, Marijke, Armagan Albayrak, and Richard Goossens. "Innovating Health Care: Key Characteristics of Human-Centered Design." *International Journal for Quality in Health Care* 33, no. S1 (2021): 37–44. <https://doi.org/10.1093/intqhc/mzaa127>.
- Michie, Susan, Maartje M. van Stralen, and Robert West. "The Behaviour Change Wheel: A New Method for Characterising and Designing Behaviour Change

- Interventions.” *Implementation Science* 6, no. 1 (2011): article no. 42. <https://doi.org/10.1186/1748-5908-6-42>.
- Michie, Susan. “Implementation Science: Understanding Behaviour Change and Maintenance.” *BMC Health Services Research* 14, no. S2 (2014): O9. <https://doi.org/10.1186/1472-6963-14-S2-O9>.
- Nimishakavi, Sheela. “The Long-Lasting Wages of Neglect: Flint Residents Plagued Again by Water Crisis.” *Non-Profit Quarterly*, October 10, 2016. <https://nonprofitquarterly.org/long-lasting-wages-neglect-flint-residents-plagued-water-crisis/>.
- Nold, Christian. “Towards a Socio-material Framework for Systems in Design.” Working paper, UAL Social Design Institute, 2021. <http://oro.open.ac.uk/79395/>.
- Norman, Donald A. *The Design of Everyday Things*, rev. and expanded ed. New York: Basic Books, 2013. First published 1988.
- OECD. *Tools and Ethics for Applied Behavioural Insights: The BASIC Toolkit*. Paris: OECD Publishing, 2019.
- Otto, Betsy, Samantha Kuzma, Colin Strong, and Marlena Chertock. “Combating the Coronavirus without Clean Water.” *World Resources Institute*, April 8, 2020. <https://www.wri.org/insights/combating-coronavirus-without-clean-water>.
- Pereno, Amina, and Silvia Barbero. “Systemic Design for Territorial Enhancement: An Overview on Design Tools Supporting Socio-technical System Innovation.” *Strategic Design Research Journal* 13, no. 2 (2020): 113–36. <https://doi.org/10.4013/sdrj.2020.132.02>.
- Perera, Dulmini. “Wicked Problems, Wicked Play: Fun Machines as Strategy.” *FormAka-demisk: Research Journal of Design and Design Education* 13, no. 2 (2020): article no. 1. <https://doi.org/10.7577/formakademisk.3378>.
- Peters, B. Guy, and Nenad Rava. “Policy Design: From Technocracy to Complexity, and Beyond.” In *Proceedings of IPPA International Public Policy Conference*, 1–23. Singapore, June 28–30, 2017. <https://www.ippapublicpolicy.org/file/paper/5932fa23369d0.pdf>.
- Rahman, K. Sabeel. “Constructing Citizenship: Exclusion and Inclusion Through the Governance of Basic Necessities.” *Columbia Law Review* 118, no. 8 (2018): 2447–2503. <https://columbialawreview.org/content/constructing-citizenship-exclusion-and-inclusion-through-the-governance-of-basic-necessities/>.
- Reijula, Samuli, and Ralph Hertwig. “Self-Nudging and the Citizen Choice Architect.” *Behavioural Public Policy* 6, no. 1 (2022): 119–49. <https://doi.org/10.1017/bpp.2020.5>.
- Rittel, Horst W. J., and Melvin Webber. “Dilemmas in a General Theory of Planning.” *Policy Sciences* 4 (June 1973): 155–69. <https://doi.org/10.1007/BF01405730>.
- Rutter, Harry, Natalie Savona, Ketevan Glonti, Jo Bibby, Steven Cummins, Diane T Finegood, Felix Greaves et al. “The Need for a Complex Systems Model of Evidence for Public Health,” *Lancet* 390, no. 10112 (2017): 2602–4, [https://doi.org/10.1016/S0140-6736\(17\)31267-9](https://doi.org/10.1016/S0140-6736(17)31267-9).
- Sanders, Michael, Veerle Snijders, and Michael Hallsworth. “Behavioural Science and Policy: Where Are We Now and Where Are We Going?” *Behavioural Public Policy* 2, no. 2 (2018): 144–67. <https://doi.org/10.1017/bpp.2018.17>.
- Sangiorgi, Daniela. “Transformative Services and Transformation Design.” *International Journal of Design* 5, no. 2 (2011): 29–40. <http://www.ijdesign.org/index.php/IJDesign/article/view/940/344>.
- Schmidt, Ruth. “Strange Bedfellows: Design Research and Behavioral Design.” In *Co-creation*, vol. 3 of *Proceedings of DRS 2020 International Conference*, edited by Stella Boess, Ming Cheung, and Rebecca Cain, 1443–57. London: Design Research Society, 2020. <https://doi.org/10.21606/drs.2020.252>.
- Schmidt, Ruth, and Katelyn Stenger. “Behavioral Brittleness: The Case for Strategic Behavioral Public Policy.” *Behavioural Public Policy* (May 7, 2021): 1–26. <https://doi.org/10.1017/bpp.2021.16>.

- Schmidt, Ruth, and Katelyn Stenger. "Behavioral Planning: Improving Behavioral Design with 'Roughly Right' Foresight." *Strategic Design Research Journal* 14, no. 1 (2021): 138–48. <https://doi.org/10.4013/sdrj.2021.141.12>.
- Schmidt, Ruth, and Katelyn Stenger. "Overcoming Bounded Scalability: Achieving Interoperability through Behavioral Boundary Objects." *Advances in Creativity, Innovation, Entrepreneurship and Communication of Design. Proceedings of the AHFE 2021. Lecture Notes in Networks and Systems*, vol. 276, edited by Evangelos Markopoulos, Ravindra S. Goonetilleke, Amic G. Ho, and Yan Luximon, 3–10. Cham: Springer, 2021. https://doi.org/10.1007/978-3-030-80094-9_1.
- Schmidt, Ruth. "A Model for Choice Infrastructure: Looking beyond Choice Architecture in Behavioral Public Policy." *Behavioural Public Policy* (2022): 1–26. <https://doi.org/10.1017/bpp.2021.44>.
- Schön, Donald A., and Martin Rein. *Frame Reflection: Toward the Resolution of Intractable Policy Controversies*. Boston: Basic Books, 1994.
- Star, Susan Leigh, and James R. Griesemer. "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39." *Social Studies of Science* 19, no. 3 (1989): 387–420. <http://www.jstor.org/stable/285080>.
- Stillman, Sarah. "Can Behavioral Science Help in Flint." *New Yorker*, January 17, 2017. <https://www.newyorker.com/magazine/2017/01/23/can-behavioral-science-help-in-flint>.
- Thomas, Fabian, Estelle Midler, Marianne Lefebvre, and Stefanie Engel. "Greening the Common Agricultural Policy: A Behavioural Perspective and Lab-in-the-Field Experiment in Germany." *European Review of Agricultural Economics* 46, no. 3 (2019): 367–92. <https://doi.org/10.1093/erae/jbz014>.
- Toy, Sarah. "Why Some Healthcare Workers Would Rather Lose Their Jobs Than Get Vaccinated." *Wall Street Journal*, October 22, 2021. <https://www.wsj.com/articles/covid-19-vaccinations-healthcare-workers-refuse-risk-jobs-11634915929>.
- Trochim, William M., Derek A. Cabrera, Bobby Milstein, Richard S. Gallagher, and Scott J. Leischow. "Practical Challenges of Systems Thinking and Modeling in Public Health." *American Journal of Public Health* 96, no. 3 (2006): 538–46. <https://doi.org/10.2105/AJPH.2005.066001>.
- Vink, Josina, Katarina Wetter-Edman, and Kaisa Koskela-Huotari. "Designerly Approaches for Catalyzing Change in Social Systems: A Social Structures Approach." *She Ji: The Journal of Design Economics and Innovation* 7, no. 2 (2021): 242–61. <https://doi.org/10.1016/j.sheji.2020.12.004>.
- Whitney, Patrick. "Design and the Economy of Choice." *She Ji: The Journal of Design, Economics, and Innovation* 1, no. 1 (2015): 58–80. <https://doi.org/10.1016/j.sheji.2015.09.001>.
- Whitney, Patrick, and André Nogueira. "Cutting Cubes Out of Fog: The Whole View of Design." *She Ji: The Journal of Design, Economics, and Innovation* 6, no. 2 (2020): 129–56. <https://doi.org/10.1016/j.sheji.2020.04.001>.
- Winner, Langdon. "Do Artifacts Have Politics?" In *Computer Ethics*, 2nd ed., edited by John Weckert, 177–92. London: Routledge, 2017.