

Wicked Solutions for Wicked Problems:

Misalignment in Public Policy

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ABSTRACT: “Wicked problems” are often thought of as a situation that should not exist or an inescapable consequence of complex systems. This paper argues for a paradigm shift in understanding wicked problems as *feedback* from the system (i.e., the real world), resulting from a misalignment between our mental model of the system and the system itself, rather than inevitable outcomes of complex systems. Through a systems literature review (SLR) on effective policy and two surveys sampling the US population in order to understand how people are thinking about today’s biggest crises, this paper explores the prevalence of this traditional approach to problem solving. Essentially, wicked problems are the real-world system informing us that our mental model is flawed. When confronted with wicked problems involving webs of causality (as all wicked problems do), people often fail to recognize the needed solutions as a *corollary web of actions*, instead emphasizing linear causal relationships, or “root causes.” This problem-solving approach has significant consequences, as it overlooks the symmetry between the web of causality generating the problems and the web of solutions that would remedy them. This oversight leads to the implementation of partial solutions divorced from the dynamacy of interaction effects, which in turn leads policy and decision makers to conclude that critical parts of a web of solutions have been ineffective, and thus excluding them from future interventions. This is especially relevant for influential policy makers, planners, and decision makers. However, changing this mindset is in itself a wicked problem. The traditional approach to problems and systems is ineffective, necessitating a more systemic approach to policy. Our statistically significant findings confirm the prevalence of the traditional approach, prompting the recommendation for a more holistic education in critical analysis and systems thinking to address the web of causes that produce “wicked problems.” This is particularly critical for individuals being trained for careers in policy and planning.

Keywords: policy | public policy | policy education | policy curriculum | systems thinking | wicked problems | effective policy | grand challenges

Introduction

This paper builds on prior research regarding how society approaches the most wicked problems facing the world today [1]. Specifically, we conducted a systems literature review to critically examine the field of effective policy design, implementation, and evaluation. Additionally, we conducted two surveys to determine how public perception of wicked problems and their solutions influence public policy strategies. Based on the literature review and the survey findings, we conclude with recommendations for improving the preparation of public policy students through incorporating systems thinking into program curriculum.

Public policy students are trained “to address the world’s most complex policy challenges” [2]. This requires first understanding these complex challenges, and then learning and mastering the theoretical tools, models, concepts, and frameworks needed to tackle these problems. In theory, equipped with this toolkit and armed with this understanding, they should then be able to select the appropriate tools, develop the appropriate framework, and design an effective policy to solve them. In practice, we see that these complex problems persist and that our policies have been insufficient to completely solve them. The predominant approach to problem-solving is ineffective, as challenges continue to overwhelm our repertoire of tools, models, concepts, and frameworks.

By seeking to understand how people are thinking about problems, we endeavor to shed light on the underlying factors that impede our ability to successfully mitigate wicked problems. Through a mixed methods exploration of the topic, we examine how people think about complex issues in order to better understand how we can shift our thinking to better tackle wicked problems.

A comprehensive review of the literature on effective policy design found that there is a general lack of consensus on how we 1) define and 2) measure “efficacy” in policy design and implementation. Through a systemic analysis of 59 scholarly publications centered on effective policy, we found that the majority of papers comprised non-empirical publications, discussing a variety of researchers’ perspectives and opinions on what makes an effective policy. From this we conclude there is a dearth of empirical evidence and coherence in policy design and implementation. These gaps impede our ability to design effective policy solutions for complex issues.

Our research has revealed a critical misalignment between the traditional problem-solving approaches that we are taught and the complexities of the real world. It is this misalignment that prevents us from solving today’s wicked problems. These “wicked problems” as termed by design theorists Horst Rittel and Melvin Webber in 1973, are systemic and interconnected, making them difficult to define and solve [3]. Unlike traditional problems that have clear solutions, wicked problems require equally complex and systemic solutions that take into account the web of causes. A web of causality describes how multiple factors or variables are interconnected and interact with each other in complex systems, leading to multiple and often unexpected outcomes.

In this context, the causes and effects of a problem are not linear or straightforward, but rather they are part of a complex network of relationships and interactions that make it difficult to isolate and solve

individual problems without considering their interconnectedness. Understanding webs of causality is critical for developing effective solutions to complex problems. In contrast, the scientific method, which teaches students to isolate one variable at a time and to study them in vitro in order to understand how they function, is held up as the gold standard for discovery and knowledge-making. Despite being the primary way in which we create knowledge and then develop solutions to address problems, this approach fails to consider the greater context in which variables interact in the real world.

In this paper, we examine the mismatch between the complexities of our problems and the solutions we use to address them. We suggest that shifting our thinking to better align with the systemic nature of these problems will achieve more accurate and effective results in the policy-making process. By understanding the complexities of the real world, policy makers can craft wicked solutions to tackle wicked problems. To do this, we first need to comprehend the feedback we are getting from reality, which can best be accomplished through learning, practicing, and implementing the principles of systems thinking.

The real world, reality, is VUCA – Volatile, Uncertain, Complex, and Ambiguous [4]. The world is non-linear, and our biggest challenges have webs of causes, rather than a single or root cause. Yet, as humans, we have a tendency to compartmentalize problems, and we fail to take into account the true nature of our world, making it difficult to effect meaningful change. To navigate this complexity, we need tools that help us recognize the feedback we are constantly receiving from reality. By first understanding the systems in which we are embedded, we can better align our thinking and our actions to create solutions that address the wicked problems we face, rather than the feedback of the problems. Openly receiving this feedback enables us to course-correct and change our behavior, our choices, and our approach to solving problems. However, feedback, or symptoms, are often misinterpreted and compartmentalized, causing us to isolate specific attributes to solve complex problems instead of recognizing the big picture. Humans tend to seek out linear causal pathways in a non-linear world, missing the fact that all wicked problems exist in webs of causality. It is clear we need a paradigm shift that accounts for the complexity of the systems we live in. Systems thinking is one such approach. Amongst the top forty public policy analysis graduate school programs in the United States, only three of these programs offer any kind of programming in systems thinking [5]. Without adequate training in systems thinking and methods, policy students' ability to understand and address these issues will remain limited, and complex problems will persist.

Despite living in a VUCA world, our thinking is often constrained by what Drs. Derek and Laura Cabrera call LAMO - Linear, Anthropocentric, Mechanistic, and Overly Ordered [6] thinking. In linear thinking, people assume a straightforward, cause-and-effect relationship between events. They tend to see problems in a one-dimensional way, and focus on the immediate, short-term effects of actions rather than considering long-term consequences. Humans think in bivalent ways (either-or) rather than multivalent (both-and). When humans think anthropocentrically, they have a myopic focus on a human-centered perspective to the neglect or exclusion of other systems or forces. In mechanistic thinking, humans comprehend the world as a machine that can be broken down into a collection of parts, and that these parts can be understood and manipulated in predictable ways. Lastly, people think in overly ordered and static categories, rather than fluid and adaptive systems. LAMO thinking prevents us from understanding wicked problems. If we do not truly understand a wicked problem, we will not be able to develop an effective strategy for mitigating it. This presents a mismatch with our perception of a problem and the

reality of the problem itself. In the realm of policy, policy makers often attempt to isolate an issue in order to solve it through a linear, ordered process, instead of recognizing a complex problem and its web of causality.

Our research investigates whether people tend to focus on linear causal relationships, instead of identifying webs of causality, and whether they are more drawn towards solutions that are bivalent, tangible, and linear, over ones that are multivalent, intangible, and nonlinear. Our proclivity to fit problems into neat theories, frameworks, or models, results in us ignoring key distinctions, systems, relationships, and perspectives. Consequently, we address only a part of the problem. These biases are rooted in LAMO thinking that prioritizes the causal relationship of X leading to Y, to the exclusion of other confounding variables that prevent us from comprehending the web of causes. To create effective solutions for wicked problems, we need to move away from LAMO thinking and embrace a more nuanced and holistic approach that accounts for the complexity of the world we inhabit. We need to understand that webs of causality require webs of solutions.

Systems Literature Review of Effective Policy

The purpose of this review was to gain a broad understanding of how researchers define what comprises an effective policy framework, and how this knowledge can be applied to policies, regardless of field or discipline. Ultimately, there is no singular definition or framework for effective policy that can be applied on scaled levels to simple and/or complex problems. Our literature discovery process, informed by Boote and Biele [7], PRISMA [8][9], and Cabrera et al. [10], took place as follows:

Coverage of the Literature

Initial review of the literature revealed that most coverage of effective policy is dedicated to historical trends, specific applications of policy to case studies, and other, mostly non-empirical publications. Following Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA) [10] multiple searches were conducted to gain an understanding of the definitions and research into how policies are formulated, and whether there is a coalescing understanding of an effective policy framework. Fifty-nine publications covering fifteen disciplines are included in this review, with the selection process detailed below. Each selected publication is summarized in Appendix A.

Selection Process

Searches were conducted in the Cornell University Library Database, Google Scholar, a general web search, and Elicit. Each search term is listed in the tables below, with their breakdown of initial items returned, the top fifty results, and each level of review. Each article went through multiple levels of review according to mutually decided criteria by the researchers: the first level reviewed the article title, the second level reviewed the abstracts, and the final level reviewed the full article text.

Fifty articles were selected from each search term's results, as determined by Cabrera's [10] recommendations for best practices in conducting a Systems Literature Review. Table 1 displays the results of each search term in the Cornell Library University database, and the total number of articles selected for each term after undergoing the levels of review.

Level of Review	Search Term												
	Attributes effective policy	Effective Crisis Policy	Effective Policy design	Effective policy formation	Effective Policy-making	Features effective policy	Holistic Crisis Policy	Policy acceptance	Proactive Reactive Solutions Policy	Successful policy design	Systemic policy design	What makes an effective policy	Total
Total Items returned	886,411	1,167,092	3,985,804	1,675,371	19,948	20,828	153,728	1,298,784	79,883	2,550,981	585,922	6,741,025	19,165,777
Top 50	50	50	50	50	50	50	50	50	50	50	50	50	600
Articles with Relevant Titles	24	48	21	17	0	3	9	27	9	32	19	8	217
Articles with Relevant Abstracts	7	8	7	2	0	1	1	3	3	16	10	4	62
Number of Articles Selected for Full Review	4	2	3	1	0	1	0	2	0	4	1	1	19

Table 1. State of the Literature from Cornell University's Library Database

Table 2 displays the results of each search term from a Google Scholar search, and the total number of articles selected for each term after undergoing the levels of review.

Level of Review	Search Term												
	Attributes effective policy	Effective Crisis Policy	Effective Policy design	Effective policy formation	Effective Policy Making	Features effective policy	Holistic Crisis Policy	Policy acceptance	Proactive Reactive Solutions Policy	Successful policy design	Systemic policy design	What makes an effective policy	Total
Total Items returned	4,380,000	4,710,000	7,060,000	5,800,000	2,430,000	7,400,000	2,490,000	5,540,000	195,000	7,240,000	5,510,000	5,560,000	58,315,000
Top 50	50	50	50	50	50	50	50	50	50	50	50	50	600
Articles with Relevant Titles	30	50	32	29	15	0	30	25	22	37	27	15	312
Articles with Relevant Abstracts	7	8	6	9	9	0	1	7	5	24	10	6	77
Number of Articles Selected for Full Review	3	2	2	6	3	0	1	4	1	10	7	1	40

Table 2. State of the Literature from Google Scholar

The search terms used for the Cornell Library database and Google Scholar were reformatted to enter into Elicit as questions, and the top ten recommendations for each question are included for analysis. Table 3 summarizes the questions entered into the AI model, and the results after undergoing the three levels of review: the article titles, the article abstracts, and the content of the articles. The results are kept separate from the assigned disciplines found in Cornell Library Database and Google Scholar, as although the articles were all determined to be relevant to the study, the authors determined they did not have any new forms of frameworks and/or insights about constructing effective policies.

Level of Review	Research Question			
	What is Effective Policy?	How are the most effective policies designed?	What are the attributes of successful public policies?	Total
Top 10	10	10	10	30
Articles with Relevant Titles	10	10	10	30

Articles with Relevant Abstracts	10	10	10	30
Number of Articles Selected for Full Review	10	10	10	30

Table 3. State of the literature from Elicit's database

Results by Search Term: Cornell Library and Google Scholar

The search term “Attributes Effective Policy” returned 886,411 results from the Cornell Library Database and 4,380,000 from Google Scholar. After reviewing the top fifty cited article titles for relevance, twenty-four articles were selected from the Cornell Library and thirty were selected from Google Scholar. An analysis of the article abstracts selected seven articles from the Cornell Library and seven articles from Google Scholar. After reviewing the full texts, four articles were selected from the Cornell Library and three articles were selected from Google Scholar.

The search term “Effective Crisis Policy” returned 1,167,092 results from the Cornell Library Database and 4,710,000 from Google Scholar. After reviewing the top fifty cited article titles for relevance, forty-eight articles were selected from the Cornell Library and fifty were selected from Google Scholar. An analysis of the article abstracts selected eight articles from the Cornell Library and eight articles from Google Scholar. After reviewing the full texts, two articles were selected from the Cornell Library and two articles were selected from Google Scholar.

The search term “Effective Policy Design” returned 3,985,804 results from the Cornell Library Database and 7,060,000 from Google Scholar. After reviewing the top fifty cited article titles for relevance, twenty-one articles were selected from the Cornell Library and thirty-two were selected from Google Scholar. An analysis of the article abstracts selected seven articles from the Cornell Library and six articles from Google Scholar. After reviewing the full texts, three articles were selected from the Cornell Library and two articles were selected from Google Scholar.

The search term “Effective Policy Formation” returned 1,675,371 results from the Cornell Library Database and 5,800,000 from Google Scholar. After reviewing the top fifty cited article titles for relevance, seventeen articles were selected from the Cornell Library and twenty-nine were selected from Google Scholar. An analysis of the article abstracts selected two articles from the Cornell Library and nine articles from Google Scholar. After reviewing the full texts, one article was selected from the Cornell Library and six articles were selected from Google Scholar.

The search term “Effective Policy Making” returned 19,948 results from the Cornell Library Database and 2,430,000 from Google Scholar. After reviewing the top fifty cited article titles for relevance, no articles were selected for further review from the Cornell Library. A total of fifteen articles were selected from Google Scholar. An analysis of the article abstracts selected nine articles. After reviewing the full texts, three articles were selected from Google Scholar for final review.

The search term “Features Effective Policy” returned 20,828 results from the Cornell Library Database and 7,400,000 from Google Scholar. After reviewing the top fifty cited article titles for relevance, three articles were selected from the Cornell Library and none were selected from Google Scholar. An analysis of the article abstracts from the Cornell Library selected one article with a relevant abstract which was also kept for full review.

The search term “Holistic Crisis Policy” returned 153,728 results from the Cornell Library Database and 2,490,000 from Google Scholar. After reviewing the top fifty cited article titles for relevance, nine articles were selected from the Cornell Library and thirty were selected from Google Scholar. An analysis of the article abstracts selected one article from the Cornell Library and one article from Google Scholar. After reviewing the full texts, only the article from Google Scholar was kept for full review.

The search term “Policy Acceptance” returned 1,298,784 results from the Cornell Library Database and 5,540,000 from Google Scholar. After reviewing the top fifty cited article titles for relevance, twenty-seven articles were selected from the Cornell Library and twenty-five were selected from Google Scholar. An analysis of the article abstracts selected three articles from the Cornell Library and seven articles from Google Scholar. After reviewing the full texts, two articles were selected from the Cornell Library and four articles were selected from Google Scholar.

The search term “Proactive Reactive Solutions Policy” returned 79,883 results from the Cornell Library Database and 195,000 from Google Scholar. After reviewing the top fifty cited article titles for relevance, nine articles were selected from the Cornell Library and twenty-two were selected from Google Scholar. An analysis of the article abstracts selected three articles from the Cornell Library and five articles from Google Scholar. After reviewing the full texts, no articles were selected from the Cornell Library and one article was selected from Google Scholar.

The search term “Successful Policy Design” returned 2,550,981 results from the Cornell Library Database and 7,240,000 from Google Scholar. After reviewing the top fifty cited article titles for relevance, thirty-two articles were selected from the Cornell Library and thirty-seven were selected from Google Scholar. An analysis of the article abstracts selected sixteen articles from the Cornell Library and twenty-four articles from Google Scholar. After reviewing the full texts, four articles were selected from the Cornell Library and ten articles were selected from Google Scholar.

The search term “Systemic Policy Design” returned 585,922 results from the Cornell Library Database and 5,510,000 from Google Scholar. After reviewing the top fifty cited article titles for relevance, nineteen articles were selected from the Cornell Library and twenty-seven were selected from Google Scholar. An analysis of the article abstracts selected ten articles from the Cornell Library and ten articles from Google Scholar. After reviewing the full texts, one article was selected from the Cornell Library and seven articles were selected from Google Scholar.

The search term “What Makes An Effective Policy” returned 6,741,025 results from the Cornell Library Database and 5,560,000 from Google Scholar. After reviewing the top fifty cited article titles for relevance, eight articles were selected from the Cornell Library and fifteen were selected from Google Scholar. An analysis of the article abstracts selected four articles from the Cornell Library and six articles

from Google Scholar. After reviewing the full texts, one article was selected from the Cornell Library and one article was selected from Google Scholar.

Applied PRISMA Search

The next step in our literature selection process is an Applied PRISMA Search, as described by Cabrera [10]. This method was utilized to gain an understanding of the general knowledge outside of scholarly articles, and found by searching for “Characteristics of Effective Policy.” The top ten websites and book results are displayed in Table 4.

Rank	Websites	Books
#1	Characteristics of good policies and why it matters [11]	Characteristics of Effective Education Policy and Variation in Effect by Student Demographics [12]
#2	Characteristics of good policies and procedures [13]	A Comparison of Effective Leadership Characteristics and Policy Implementation [14]
#3	Characteristics of a good policy [15]	Policy Making and Effective Leadership [16]
#4	Characteristics of Successful Public Policy [17]	Education Policy Studies: A Practical Approach [18]
#5	Qualities of a Good Policy [19]	Microfoundations of Policy Implementation: Towards European Best Practices [20]
#6	What is a Policy? [21]	Improving Healthcare Quality in Europe: Characteristics, Effectiveness, and Implementation of Different Strategies [22]
#7	What makes a Good Policy: Five Watchwords [23]	The Doctor of Nursing Practice Project: A Framework for Success [24]
#8	Characteristics of good and Effective Policy [25]	Policy that Works for Forests and People: Prospects for Governance and Livelihoods [26]
#9	Policy Meaning and Definition & Characteristics of Policy [27]	Education and Training Policy Teachers Matter: Attracting, Developing, and Retaining Effective Teachers [28]
#10	Effective Policy - 17 Characteristics of Good Policy [29]	Identifying and Assessing Policy Characteristics' Role In Communicable Disease Transmission During the SARS-CoV-2 Pandemic [30]

Table 4. Applied PRISMA on Policy

Wikipedia results, dictionaries, and thesauruses were excluded from the top ten results selected. From this general search, we see that the characteristics of good, effective, and/or successful policies are readily

available for the general public to find. There is a wide breadth of opinion and examples of successful policies, whether applied to the workplace, public policy, disaster response, and other topics. The top ten books on effective policy were found searching for “effective policy” in Amazon Books and sorting the list by reviews, with the top ten results in the right column of Table 4. The breadth of available information and opinions on effective policy is just as wide-ranging as what is found through a general web search. This wide range of resources on policy application, opinion on success/failure, framework development, and more can be seen in the Synthesis of the Literature section of this review.

‘Hasty’ Top Scholar Search

The third step of this literature review was a quick search of the top researchers in the field of policy analysis. Selecting these top scholars was based on if they were analyzing general policy frameworks and applications, rather than individual case studies that could not be extrapolated to fit the wider field. Including the term “Scholar” or “Researcher” in the searches resulted in finding college degrees or public policy programs. Searches for “Effective Policy Framework” and “Successful Policy Development” returned primarily results for specific case studies, not broad examples of successful frameworks. As public searches were not working to narrow the field of policy researchers, we returned to the list of publications already found through the Cornell Library Database and Google Scholar, and looked at researchers who had published broad examinations of public policy. No new publications were discovered through this method of searching other than those that were already selected, but several scholars in the field of policy analysis are laid out in the Hasty Scholar analysis in Table 5.

Scholar	Affiliation	Number of Articles Selected from Publications
Prof. Dr. Isabelle Stadelmann-Steffen	University of Bern	1
Dr. Judith de Groot	University of Groningen	1
Dr. Stephen Linder	UTHealth School of Public Health	2
Professor Brian Head	University of Queensland	1
Professor Patricia W. Ingraham	Syracuse University	1

Table 5: Notable Policy Scholars from the Cornell Database and Google Scholar Searches

Synthesis of the Literature

The review of available literature on policy analysis suggests that research is split between case analyses of policy application, various frameworks for application, studying historical policymaking, and other

topics. We were able to categorize the literature into either the application or study of effective policy, cutting out narrowly-scoped case studies and fragmented applications. From workplace operations to disaster response, there is a broad range of topics that policies cover. Indeed, it is this wide variety of possible subjects that contributes to the difficulty in establishing a cohesive definition for what makes effective policy. Scholars often discuss how to inform policy-making to make it more effective, without giving a definition of what “effective policy” means. Metanalyses of successful policy implementation points out that we find:

“little in the way of comparisons across findings for different types of policies. Even where multiple policy decisions are examined, the focus has been on one specific contextual factor, such as national government influence, local laws, or ideological similarity, rather than on the nature of the policies themselves” [31].

We see this contextual focus specifically in publications focusing on singular elements of policy design and implementation. For example, Hoppe [32] describes successful policy implementation as a “better match between the products of civil servants and the expectations of politicians.” This description fails to consider or include stakeholders beyond politicians and civil servants. Head [33] discusses the need for “evidence-informed” policy, to reduce the influence of political agendas and other factors on policy implementation, contradicting Hoppe’s focus on the alignment between politics and policy. These discussions on how policy should be informed do not translate to a cohesive definition for successful and/or effective public policy frameworks.

Policy Analysis Across Disciplines

Research on effective policy design spans across many disciplines. The majority of research is conducted in the field of public policy (20.3%), with the second most common discipline found to be the study of policy design and implementation (16.9%). The categories of policy design and implementation ranged from academic research conducted on the history and evolution of design and implementation to examining the various frameworks for effective design. Figure 1 illustrates the majority of disciplines, ranging from the smallest category of economics to the largest category of general public policy.

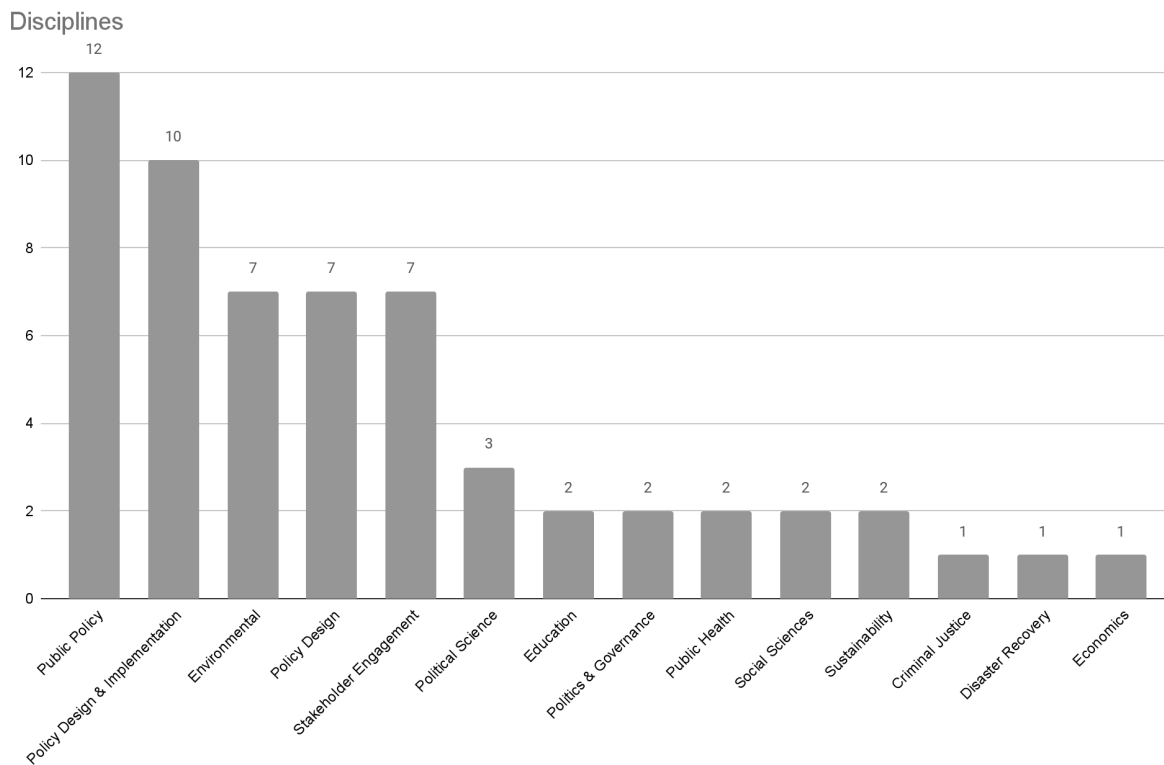


Figure 1: Disciplines of the Selected Literature (n=59)

This overview of disciplines reveals that many scholars take either a very broad lens in their discussions of public policy, or very narrow (as seen in the categories of criminal justice, disaster recovery, and economic policy). Searching for a clear framework and recommendations for how to craft and implement effective policy led to vastly different interpretations.

Synthesis of Methods

Research methods varied widely across the fifty-nine publications (see Figure 2). They represented twenty-four conceptual/editorial papers, ten case studies, ten mixed methods (two or more methods), eight literature reviews, four experimental studies, and three focused on policy models or modeling techniques.

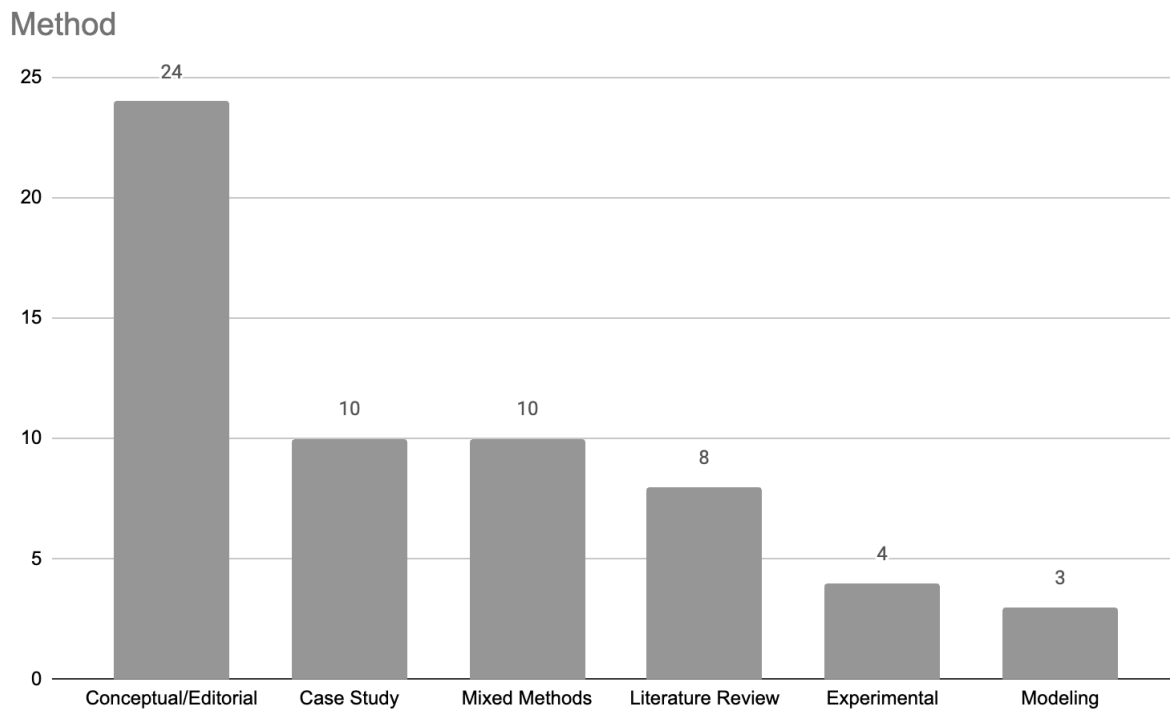


Figure 2: Methods of Selected Literature (n=59)

From the research methods identified across these publications, 41% (24/59) were conceptual, editorial, or non-methodological with no empirical findings. Of the empirical methods, 59% (35/59) only 7% (4/59) were experimental. As shown in Figure 3, 28% (13/46) had statistical significance. Thus, much of the work in this domain is inconclusive or speculative; opinion is high but evidence is low.

In the literature, there were variations in empirical validity. Thirteen of the studies performed statistical tests on their results, as seen in Figure 3. Reasons for utilizing statistical methods vary across the articles, from Corbin [34] looking at the successful application of policies on social justice outcomes post-Hurricane Katrina, to Howlett's [35] meta-analysis of empirical studies on the mix of policy tools and their relevant outcomes.

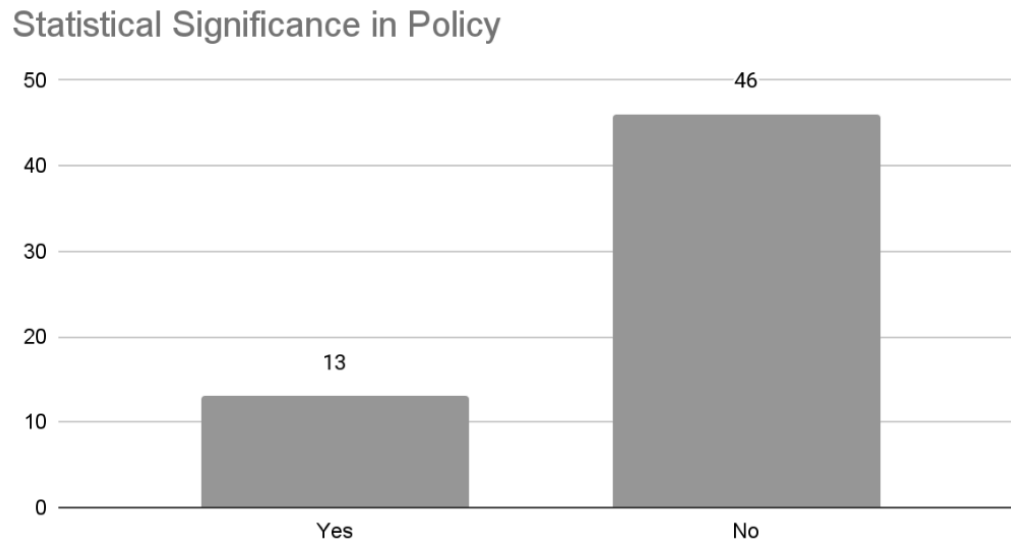


Figure 3: Statistical Status of the Selected Literature (n=59)

The lack of statistical significance in policy research leaves policy developers without solid evidence to base policy frameworks on. The speculative nature of policy articles sway between scholar opinions of effective policy frameworks, and not evidence-based research.

Categories of Policy Research

We thematically coded articles into four main categories, through printing the datasheet of article titles and summaries, cutting each into individual strips of paper, and arranging them thematically, according to systemic literature review practices [10]. As seen in Figure 4, the “design” category relates to literature that focuses on the elements that make up designing a policy: tools, frameworks, contexts, and more. This made up the largest category (42%) of publications. The second largest category (24%), “stakeholder engagement/people” encompasses the literature that highlighted community participation as a key element of the policy construction process. The “systemic approaches” category fell under what we determined to be multi-faceted, holistic applications and designs of policy. The “history” category included studies of policy evaluation and analysis, where no frameworks were necessarily recommended, but the researchers engaged more in scholarly analysis such as trends over time. This thematic coding allowed us to analyze the quantity and quality of papers in each thematic group.

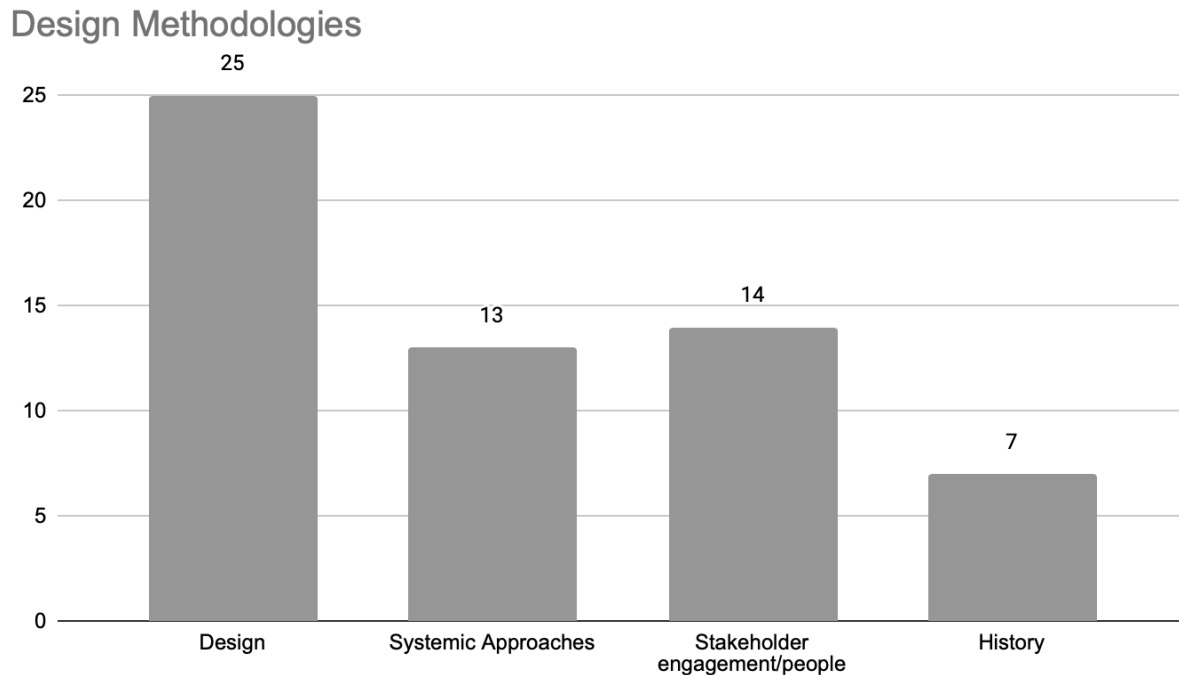


Figure 4: Categorizations of Policy Literature (n=59)

A major takeaway from this categorization is the lack of stakeholder engagement being included as a design factor in the majority of policy frameworks.

Significance and Conclusion

The analysis of these fifty-nine studies revealed a range of practical and scholarly implications regarding effective policy. The literature primarily consisted of conceptual, editorial or historical discussions of effective policy (n=24), while only a few papers offered practical recommendations for scientists, organizations, or the general public. Much of the literature emphasized the importance of improving policy in the context of disaster recovery and drawing lessons from the COVID-19 pandemic. This interest was evident in both the included studies and the niche literature that was not part of the review. The absence of a standardized understanding of effective policy frameworks was identified as a challenge. Establishing a common definition of effective public policy, applicable to both simple and complex societal issues, in addition to more studies including empirical and statistically validated data, would enhance the scholarly significance of the field. Implementing these suggestions would improve the validity and reliability of policy formation methods and contribute to the overall advancement of policy making.

Survey Design

“What’s the Crisis? (2)” Survey

In the study, “What is the Crisis?” by Cabrera et al. [1], Cornell University faculty were asked to “identify the most important crisis humanity currently faces,” and subsequently rank and rate them based on solvability. Expanding on this research, we conducted a follow-up survey, “What’s the Crisis? (2)” (refer to Appendix B). This survey aimed to determine the most important crisis humanity *currently* faces according to a representative sample of the United States population. Additionally, participants were asked to identify the primary cause of the crisis and who is primarily responsible for solving it. The purpose of the survey was to assess if Americans’ concerns regarding crises have changed since the 2008 “What is the Crisis?” study and to understand their understanding of the cause(s) of these crises. By evaluating who participants perceive as primarily responsible for solving the crises, we aimed to examine their perception of the role of institutions compared to individual agents in addressing these issues. Through this survey, we obtained a general overview of the pressing issues that the United States population believes are facing humanity.

“Solving Problems” Survey

To explore Americans’ understanding of webs of solutions, we conducted a second survey titled the “Solving Problems” survey (refer to Appendix C). This survey aimed to determine whether participants could recognize an evidence-based web of solutions and understand that all the solutions needed to be implemented for effectiveness. Participants were presented with two different wicked problems: mass shootings and wildfires. For each issue, participants were asked: “How concerned are you with the occurrence of [mass killings¹/wildfires]?” and “In your opinion, how solvable is the issue of [mass killings/wildfires]?” For each issue, participants were then asked to “explain the rating you gave... about solvability.” Next, participants were presented with a corollary web of solutions specific to each issue and asked to rate “how effective you believe each possible solution would be in solving the issue of [mass killings/wildfires].” The web of solutions presented for each issue was the result of research into these two wicked problems.

Our research on addressing mass killings was sourced primarily from the book, *The Violence Project: How to Stop a Mass Shooting Epidemic*, authored by Drs. Jillian Petereson and James Densley [36]. Frustrated by reactionary policy conversations that have yet to solve the problem of mass shootings, the authors propose an evidence-based web of solutions to address the wicked problem of mass shootings. The book presents twelve recommendations categorized into three levels (individual, institutional, and societal) across four areas (trauma, crisis, social proof, and opportunity). These twelve recommendations represent what can be done collectively to combat the mass shooting epidemic. The “Solving Problems” survey utilized recommendations from *The Violence Project* to assess participants’ recognition of the need for an evidence-based web of solutions and whether they perceived all the solutions as effective.

¹ Due to the potentially politically polarizing nature of the term “mass shootings,” the survey used the less controversial term “mass killings.”

Methods

Both surveys, “What’s the Crisis? (2)” and “Solving Problems,” were developed in Alchemer and administered via Cloud Research. They consisted of a combination of open-ended and ranked questions and followed a cross-sectional survey design. The surveys underwent multiple rounds of pilot testing for comprehension, language, and construct validity with the research team and acquaintances. The finalized surveys received approval from the Institutional Review Board (IRB). The surveys were limited to participants in the United States, and the demographics aimed to be representative of the U.S. population. Participants were compensated \$3 for completing the survey. Participants in the first survey were excluded from taking the second survey.

In the first survey, “What’s the Crisis? (2)” (refer to Appendix B), participants were asked to complete the sentence “The most important crisis humanity currently faces is...” and provide the primary cause for the identified crisis. They were also asked “Who is primarily responsible for solving this crisis? (Select all that apply)” and provided with a list of 12 options to select from: charities, churches/religious organizations, corporations, individuals, local communities, local/state government, media organizations, national government, non-profit organizations, research institutions, schools, other - write in (required). Participants were required to select at least one option, could choose multiple options, and could provide an open-ended response. They were then presented with a predefined list of crises adapted from the “What is the Crisis? (1)” study and asked to rank the top five crises in order of importance and solvability (refer to Appendix B). After data cleaning—three responses were removed that were completed by respondents not in the United States—the final sample consisted of 451 responses. Open-ended responses were analyzed using a word cloud generator to identify the most common words and phrases. The results of Survey 1 informed the development of Survey 2.

The purpose of the second survey, “Solving Problems” (refer to Appendix C), was to explore people’s perspectives on solving a specific complex problem and assess the extent to which their perspectives aligned with systems thinking. The participants for this survey represented a normal population distribution for the United States. Participants were asked “how **concerned** are you with the occurrence of mass killings?” and “In your opinion, how **solvable** is the issue of mass killings?” Both questions asked participants to rate their response on a likert scale (1-5). They were also asked to explain their ratings for solvability in an open-ended response. Participants were then presented with a list of solutions and asked to rate the effectiveness of each solution on a Likert scale (1-5) from “not at all effective” to “extremely effective.” After data cleaning—223 responses were removed that were incomplete, completed by respondents not in the United States, and/or that had non-sensical responses to open-ended questions—the final sample consisted of 413 responses.

The list of solutions was derived from *The Violence Project: How to Stop a Mass Shooting Epidemic* [37]. To avoid double-barreled survey questions, the twelve recommendations from the book were expanded to sixteen (refer to Appendix C). The survey included a parallel set of questions regarding wildfires, which were not analyzed for this paper due to time constraints but may be analyzed in the future.

Data collected from the “Solving Problems” survey were analyzed using K-means cluster analysis, factor analysis, and pairwise comparison. Stata, R, and Excel were used for data analysis. For further insight into mass killings, the research team interviewed Dr. James Densley, which was recorded and later summarized with the assistance of ChatGPT by OpenAI.

Results

“What’s the Crisis? (2)” Survey

We analyzed the raw data from the two key open-ended questions: 1) “The most important crisis humanity currently faces is...” and 2) “In a few words, if you were to identify the primary cause(s) for the crisis you identified in the previous question, what would it/they be?” We performed a textual analysis of word types and their synonyms and removed stop words. Word clouds were utilized to examine the data visually. The word clouds presented in this paper visually represent the qualitative data, with word size indicating frequency in the responses.

Figure 5 presents a word cloud based on 451 responses, depicting the frequency of words in answer to the open-ended question, “The most important crisis humanity currently faces is...” After removing stop words and accounting for synonyms, there were 963 words remaining, of which 270 were unique. The word cloud displays the fifty most commonly occurring words from participants' answers to this question.

Figure 5: Word cloud of responses to “The most important crisis humanity currently faces is...”



These patterns are also reflected in the quantitative data. The top ten most frequently mentioned words are reflected in Table 6.

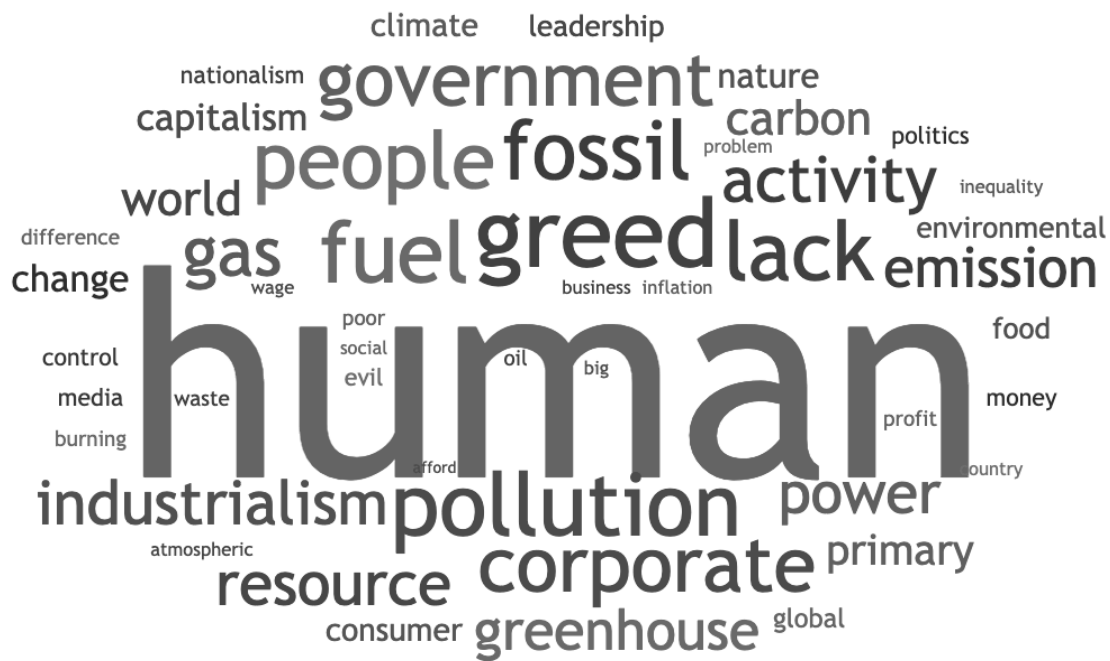
Table 6: Top 10 words from responses to “The most important crisis humanity currently faces is...”

Rank	Word	Occurs (Total 963)	%
1	climate	144	14.95%
2	change	137	14.23%
3	global	49	5.09%
4	warming	47	4.88%
5	poverty	24	2.49%
5	war	24	2.49%
7	nuclear	15	1.56%
8	inequality	14	1.45%
8	inflation	14	1.45%
10	hunger	12	1.25%
10	lack	12	1.25%

Figure 5 demonstrates “climate” and “change,” almost always appearing together as “climate change” (n=137), were the most frequently mentioned crises identified by survey respondents. Additionally, the words “global” and “warm” were prominent. Cumulatively, the words “climate,” “change,” “global,” and “warming” accounted for 39.15% of the words used in response to this question. It is evident from the participants' responses that climate change and global warming are widely perceived as the most critical crises currently facing humanity according to the U.S. population.

Figure 6 presents a word cloud based on 451 responses, depicting the frequency of words in answer to the open-ended question, “In a few words, if you were to identify the primary cause(s) for the crisis you identified in the previous question, what would it/they be?” (Figure 6). After removing stop words and accounting for synonyms, there were 2,096 words remaining, of which 683 were unique. The word cloud displays the fifty most commonly occurring words from participants' answers to this question.

Figure 6: Word cloud of responses to “In a few words, if you were to identify the primary cause(s) for the crisis you identified in the previous question, what would it/they be?”



These patterns are also reflected in the quantitative data. The top ten most frequently mentioned words are reflected in Table 7.

Table 7: Top 10 words from responses to “In a few words, if you were to identify the primary cause(s) for the crisis you identified in the previous question, what would it/they be?”

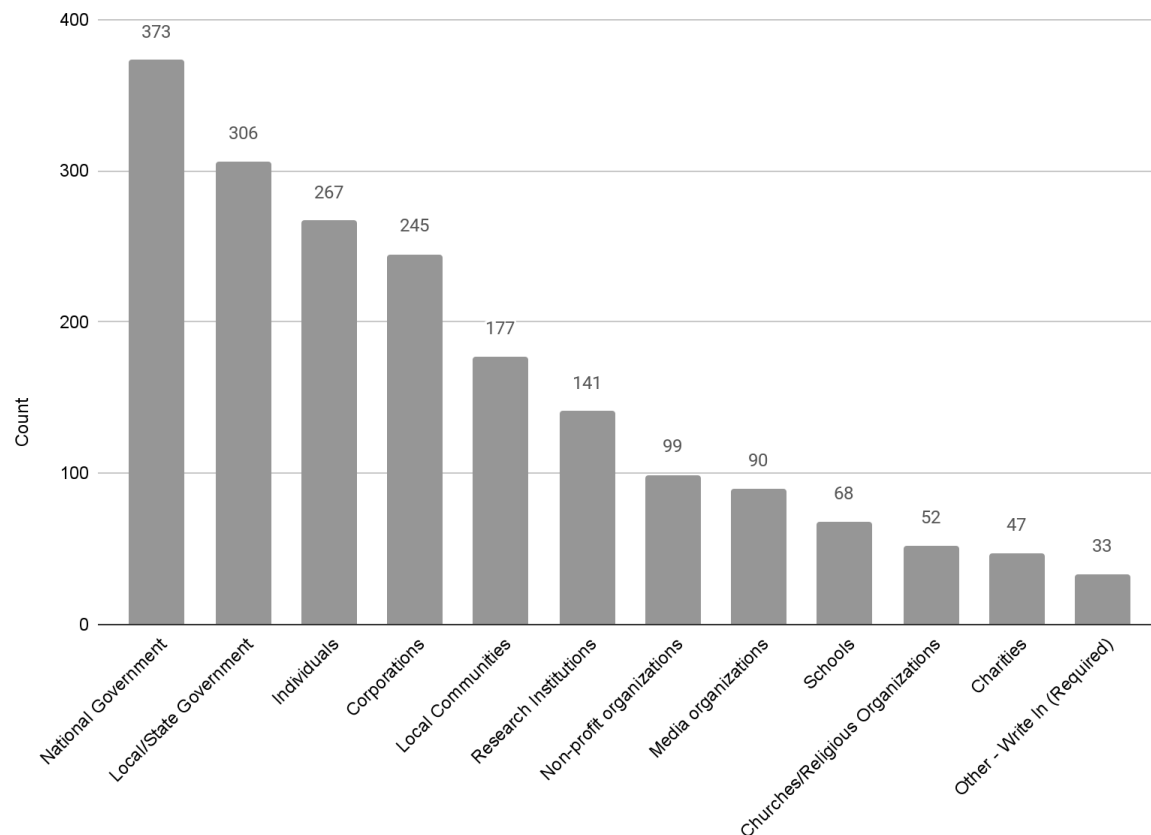
Rank	Word	Occurs (Total 2,096)	%
1	human	106	5.06%
2	greed	36	1.72%
3	cause	34	1.62%
4	pollution	33	1.57%
5	fuel	32	1.53%
6	fossil	31	1.48%
6	lack	31	1.48%
8	people	30	1.43%
9	corporate	29	1.38%
10	government	12	1.25%

The word cloud in Figure 6 demonstrates “human” to be the most common primary cause identified by survey respondents (5.06%). In comparison to Figure 5, we observe more diversity and less consensus regarding the underlying causes of the crises. Table 7 indicates that the top ten words primarily focus on human-centered or human-caused factors such as greed, pollution, fuel, corporate, and government. This suggests that participants perceive humans as the primary cause of the crises, emphasizing our agency and responsibility in addressing these challenges.

Participants (n=415) were asked, “Who is primary responsible for solving this crisis?” and presented with twelve options to choose from: charities, churches/religious organizations, corporations, individuals, local communities, local/state government, media organizations, national government, non-profit organizations, research institutions, schools, other - write in (required). Participants were required to select at least one option, could choose multiple options, and could provide an open-ended response. Figure 7 displays the frequency of each response option selected.

Figure 7: Response summary to “Who is primarily responsible for solving this crisis?”

Who is primarily responsible for solving this crisis?



The response options offered encompassed various societal institutions, with "individuals" being the notable exception. Figure 7 reveals that respondents predominantly look to national, local, and state governments as the entities responsible for addressing our most pressing crises. Notably, 89.88% of respondents selected "national government," and 73.73% chose "local/state government." In contrast, "individuals" emerged as the third most selected responsible entity, chosen by 64.34% of respondents. It is worth noting that each of these institutions comprises individuals, and as discussed earlier, complex problems necessitate comprehensive solutions involving all levels of society. A systems thinker should recognize that all of these entities, particularly individuals, have a role to play in solving these problems. If our survey takers are primarily comprised of systems thinkers, we would expect to see a more even distribution of responsible entities, reflecting the recognition of a need for a web of solutions to tackle complex problems. Instead, our results reflect society's tendency towards single, or "root cause," solutions.

The survey aimed to evaluate changes in Americans' concerns regarding crises compared to the 2008 "What is the Crisis?" study. It sought to gain a deeper understanding of their perceptions of the causes of these crises and identify who they consider primarily responsible for resolving them. In contrast to the 2008 study, our findings reveal that climate change has emerged as the most prominent crisis occupying the thoughts of Americans in 2022. While Americans generally attribute the primary causes of our crises to humans and human-related factors, they tend to exhibit an excessive focus on government as the main entity responsible for addressing and solving these crises. This focus overshadows the recognition of the importance of all institutions and the crucial role that individuals play as integral components of our societal institutions.

Solving Problems Survey

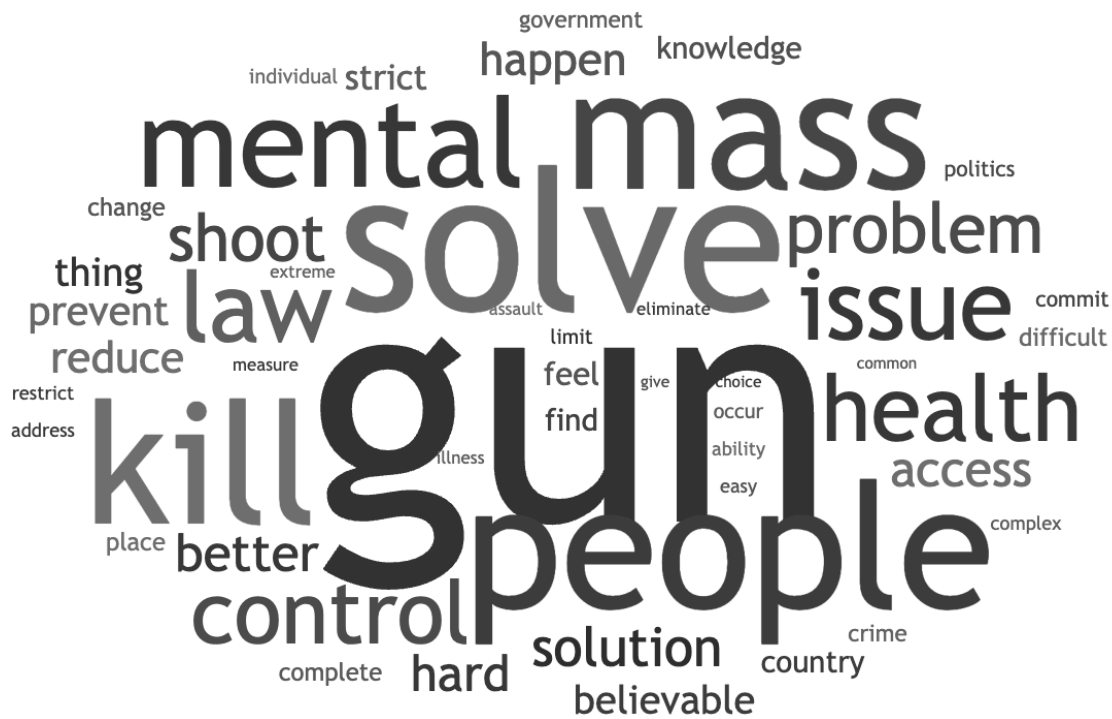
Qualitative Analysis

Respondents (n = 413) were asked eighteen questions related to mass killings to determine concern, perceived solvability, and potential effectiveness of proposed policy solutions [37].

We analyzed the raw data from the key open-ended question: 1) "Please explain the rating you gave... about [the] solvability of [mass killings]." We performed a textual analysis of word types and their synonyms and removed stop words. A word cloud was utilized to examine the data visually. The word cloud presented visually represents the qualitative data, with word size indicating frequency in the responses.

Figure 8 presents a word cloud based on 413 responses, depicting the frequency of words in answer to the open-ended question, "The most important crisis humanity currently faces is..." After removing stop words and accounting for synonyms, there were 4,193 words remaining, of which 859 were unique. The word cloud displays the fifty most commonly occurring words from participants' answers to this question.

Figure 8: Word cloud of responses to "Please explain the rating you gave... about [the] solvability of [mass killings]"



These patterns are also reflected in the quantitative data. The top ten most frequently mentioned words are reflected in Table 8.

Table 8: Top 10 words from responses to “Please explain the rating you gave... about [the] solvability of [mass killings]”

Rank	Word	Occurs (Total 4,194)	%
1	gun	228	5.44%
2	solvability	135	3.22%
3	people	120	2.86%
4	think	119	2.84%
5	kill	116	2.77%
5	mass	116	2.77%
7	mental	85	2.03%
8	issue	68	1.62%
9	law	67	1.60%
10	health	63	1.50%

The size of the words reflects the frequency of the word in the open-ended responses. The word cloud was limited to the fifty most frequently mentioned words. The word cloud in Figure 7 demonstrates that “guns” are one of the first things people think about when they think about the solvability of mass shootings. We can also see that “mental health” and “people” are two other major themes. From this, we can see that although there are a few key themes that come to mind for people when they think about solving mass shootings, guns are the thing people think about the most.

Descriptive Statistics

Table 9 shows that 42.62% of respondents (176 of 413) were extremely concerned about the occurrence of mass killings, while only 13.80% (57 of 413) believe it was extremely solvable.

Table 9: Concern & Solvability of Mass Killings

	How concerned are you with the occurrence of mass killings?	In your opinion, how solvable is the issue of mass killings?
Not at all	3.87%	7.99%
Slightly	15.01%	20.82%
Somewhat	13.56%	33.66%
Moderately	24.94%	23.73%
Extremely	42.62%	13.80%

Table 10 displays how effective the respondents believed each possible solution would be in solving the issue of mass killings. Responses were recorded utilizing a Likert Scale with the following options: “Not At All Effective,” “Slightly Effective,” “Somewhat Effective,” “Moderately Effective,” and “Extremely Effective” (analyzed utilizing 1 through 5 respectively). The lowest assessed possible solution was Solution #9, “Limit active shooter drills for children in schools” with a mean of 2.14 (Slightly Effective). Solution #13, “Reduce stigma and increase knowledge of mental health and open access to high quality mental health treatment; fund counselors in schools” received the highest rating with a mean of 3.72 (Moderately Effective).

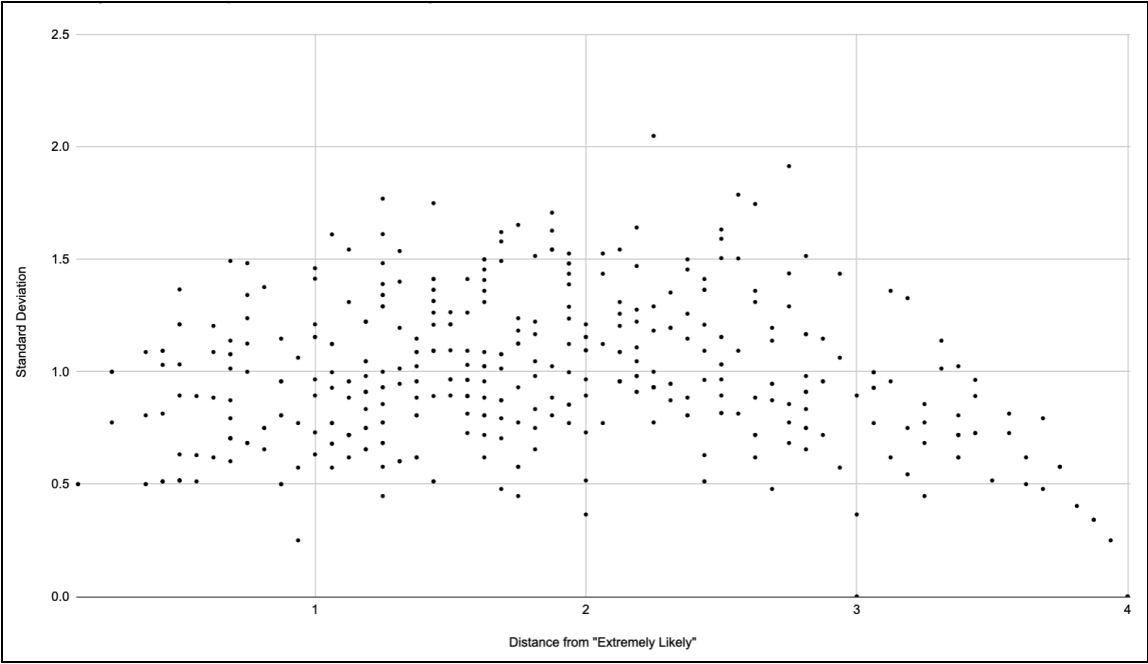
Table 10: Mean & Standard Deviation of Proposed Solutions

#	<i>Proposed Possible Solutions</i>	<i>Mean (SD)</i>
1	Adults build relationships and mentor young people.	3.45(1.14)
2	Encourage all individuals to develop strong skills in crisis intervention and prevention.	3.30(1.21)
3	Monitor our own media consumption.	2.79(1.32)
4	Safer storage of firearms.	3.36(1.36)
5	If you see or hear something, say something.	3.49(1.25)
6	Institutions of all kinds create a warm environment, follow trauma-informed practices that include knowledge about the signs, symptoms and impact of trauma	3.23(1.25)

	and avoid re-traumatization of a patient.	
7	Institutions of all kinds build care teams and referral processes and train staff.	3.15(1.22)
8	Teach media literacy in schools.	2.77(1.30)
9	Limit active shooter drills for children in schools.	2.14(1.25)
10	Institutions of all kinds implement situational crime prevention and anonymous reporting systems.	3.23(1.16)
11	Teach social emotional learning in schools.	3.27(1.26)
12	Build a stronger social safety net with adequate jobs, childcare, maternity leave, health insurance, and access to higher education.	3.55(1.29)
13	Reduce stigma and increase knowledge of mental health and open access to high quality mental health treatment; fund counselors in schools.	3.72(1.20)
14	Follow a No Notoriety protocol (this means no information is publicized about the perpetrator).	2.80(1.37)
15	Hold media and social media companies accountable for their content.	3.09(1.36)
16	Enforce universal background checks, red flag laws, permit-to-purchase, magazine limits, wait periods, assault rifle ban.	3.62(1.39)

Figure 9 displays respondents' average score (x-axis) by standard deviation (y-axis) across the sixteen questions. This graph provides a visual depiction of how people think about the proposed policy solutions to mass killings. Since these policy solutions are based on scientific research, we would expect to see the majority of people respond with "Extremely Effective."

Figure 9: Distance from “Extremely Likely” & Standard Deviation



However, this graph demonstrates the variety of perspectives that people hold when they approach a set of policy solutions even if they are based on empirical research. If the majority of society were systems thinkers, the graph would have a greater percentage of respondents in the lower right quadrant (higher average score with lower standard deviation). Instead, this graph demonstrates the various mental models that respondents had as they assessed effectiveness.

Cluster Analysis

Cluster analysis was used to divide the respondents’ into subsets and analyze the pattern of their responses. Utilizing the k-means clustering method, the respondents divided into four separate clusters based on their responses to the sixteen proposed policy solutions. Table 11 displays the number (n) of respondents in each cluster.

Table 11: Number of Respondents in K-means Clusters

	K-mean s
Cluster 1	120
Cluster 2	138
Cluster 3	105
Cluster 4	50
Total	413

K-means Clustering

K-means clustering yielded four clusters and the predictive ability for this model is an R^2/R^2 adjusted value of 0.889 / 0.887. Figure 10 shows the breakdown of each of the k-means clusters and their average responses per question. Cluster 1, with an average response of 4.15 and a standard deviation of 0.94 is denoted with an * to indicate that they are the group that most closely resembles a systems thinking approach to policy solutions. Table 12 outlines the mean and standard deviation for each question broken down by k-means cluster.

Figure 10: Average Response Score (K-means Clusters)

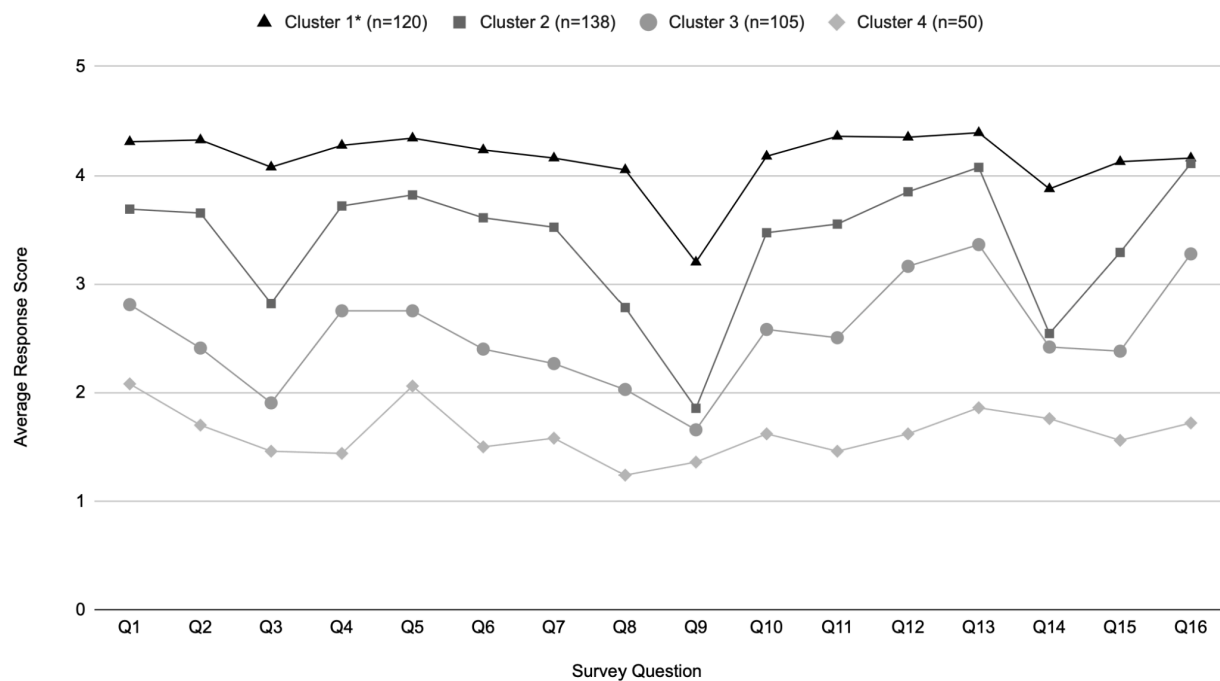


Table 12: Average Response Score (K-means Clusters)

	<i>Cluster 1*</i> (n=120)	<i>Cluster 2</i> (n=138)	<i>Cluster 3</i> (n=105)	<i>Cluster 4</i> (n=50)
<i>Q1</i>	4.31(0.78)	3.69(0.89)	2.81(0.89)	2.08(0.88)
<i>Q2</i>	4.33(0.64)	3.65(0.82)	2.41(0.83)	1.70(0.84)
<i>Q3</i>	4.08(0.87)	2.82(1.01)	1.90(0.89)	1.46(0.93)
<i>Q4</i>	4.28(0.89)	3.72(1.10)	2.75(1.19)	1.44(0.61)
<i>Q5</i>	4.34(0.88)	3.82(0.98)	2.75(1.08)	2.06(0.84)
<i>Q6</i>	4.23(0.83)	3.61(0.87)	2.40(0.85)	1.50(0.58)
<i>Q7</i>	4.16(0.84)	3.52(0.90)	2.27(0.72)	1.58(0.61)

<i>Q8</i>	4.05(0.80)	2.78(0.99)	2.03(0.99)	1.24(0.52)
<i>Q9</i>	3.20(1.35)	1.86(1.01)	1.66(0.81)	1.36(0.66)
<i>Q10</i>	4.18(0.78)	3.47(0.84)	2.58(0.90)	1.62(0.57)
<i>Q11</i>	4.36(0.73)	3.55(0.86)	2.50(0.93)	1.46(0.61)
<i>Q12</i>	4.35(0.82)	3.85(1.06)	3.16(1.14)	1.62(0.78)
<i>Q13</i>	4.39(0.79)	4.07(0.96)	3.36(0.97)	1.86(0.83)
<i>Q14</i>	3.88(1.14)	2.54(1.21)	2.42(1.19)	1.76(1.06)
<i>Q15</i>	4.13(0.88)	3.29(1.18)	2.38(1.12)	1.56(0.95)
<i>Q16</i>	4.16(1.08)	4.11(1.10)	3.28(1.36)	1.72(0.86)

Similar to Figure 10 above, Figure 11 provides visualization of how each of the K-means clusters are arrayed according to their average response and standard deviation. Cluster 1* (▲) is arrayed in the right-hand portion of the graph, which corresponds with their average responses as seen in Table 12.

Figure 11: Average Response by Standard Deviation (K-means Clusters)

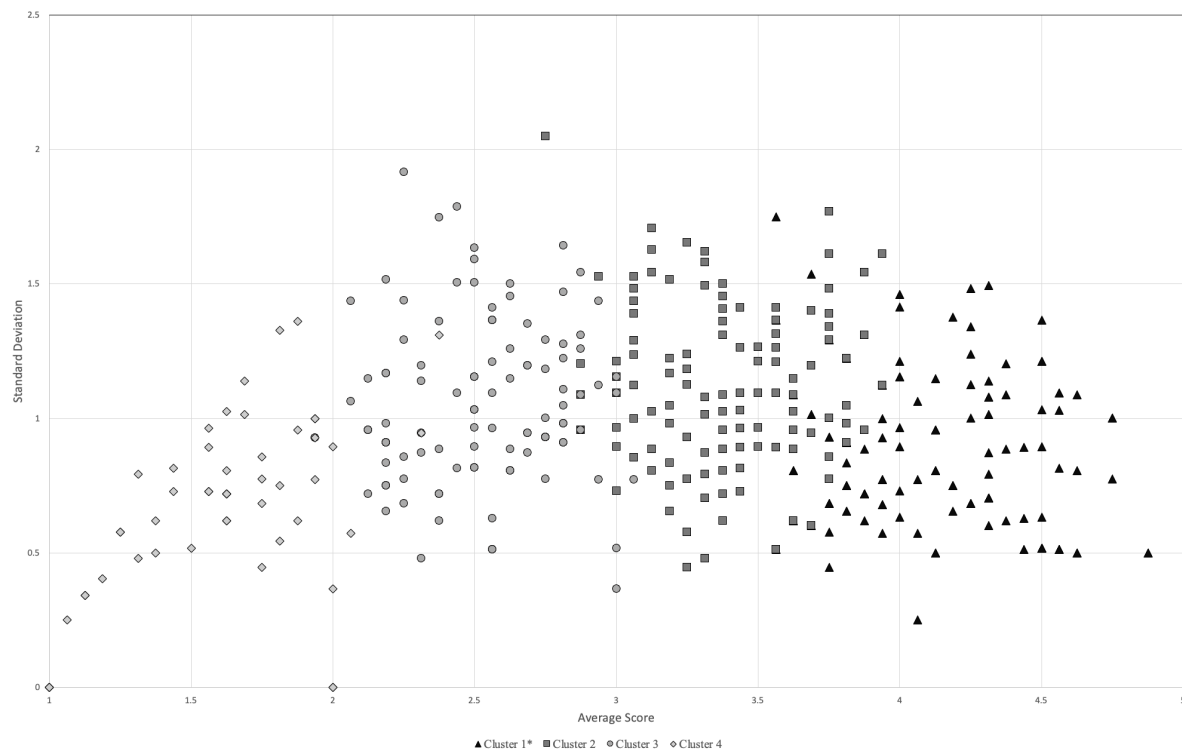


Table 13 summarizes the descriptive statistics of the k-means clusters. When conducting a linear regression analysis of descriptive statistics on the k-means clusters, there were no significant predictors of clustering at a significance level of 0.05 (5%). However, when conducting a multinomial logistic regression of the same descriptive statistics on the clusters (with a base outcome of 3), the only statistically significant predictor ($p < 0.05$) of respondents being in Cluster 1 was education level. According to the model, respondents that selected education levels of “graduated high school” and “some college, no degree” were at least 86% less likely to be in Cluster 1 as compared to those with an advanced degree.

Table 13: Summary Descriptive Statistics of K-means Clusters

	1*	2	3	4
	N=120	N=138	N=105	N=50
Education Level:				
Advanced degree (Master's, Ph.D., M.D.)	32 (26.7%)	23 (16.7%)	8 (7.62%)	7 (14.0%)
Associate degree	10 (8.33%)	8 (5.80%)	13 (12.4%)	5 (10.0%)
Bachelor's degree	53 (44.2%)	62 (44.9%)	46 (43.8%)	22 (44.0%)
Graduated high school	5 (4.17%)**	14 (10.1%)	15 (14.3%)	5 (10.0%)
Less than high school	1 (0.83%)	0 (0.00%)	0 (0.00%)	1 (2.00%)
Some college, no degree	17 (14.2%)**	30 (21.7%)	20 (19.0%)	8 (16.0%)
Trade/technical school	2 (1.67%)	1 (0.72%)	3 (2.86%)	2 (4.00%)
Gender:				
Female	63 (52.5%)	65 (47.1%)	32 (30.5%)	14 (28.0%)
Gender Variant / Non-conforming	0 (0.00%)	0 (0.00%)	1 (0.95%)	0 (0.00%)
Male	57 (47.5%)	71 (51.4%)	71 (67.6%)	36 (72.0%)
Prefer not to answer	0 (0.00%)	2 (1.45%)	1 (0.95%)	0 (0.00%)
Age:				
18 to 24	4 (3.33%)	3 (2.17%)	4 (3.81%)	0 (0.00%)
25 to 34	41 (34.2%)	47 (34.1%)	27 (25.7%)	14 (28.0%)
35 to 44	39 (32.5%)	51 (37.0%)	36 (34.3%)	16 (32.0%)
45 to 54	17 (14.2%)	18 (13.0%)	22 (21.0%)	12 (24.0%)
55 to 64	13 (10.8%)	13 (9.42%)	13 (12.4%)	8 (16.0%)
65 to 74	5 (4.17%)	1 (0.72%)	3 (2.86%)	0 (0.00%)
75 or older	1 (0.83%)	5 (3.62%)	0 (0.00%)	0 (0.00%)

	1*	2	3	4
	N=120	N=138	N=105	N=50
Race:				
2 or more	4 (3.33%)	9 (6.52%)	2 (1.90%)	0 (0.00%)
American Indian/Alaska Native	0 (0.00%)	1 (0.72%)	0 (0.00%)	0 (0.00%)
Asian	2 (1.67%)	6 (4.35%)	7 (6.67%)	3 (6.00%)
Black/African-American	24 (20.0%)	17 (12.3%)	9 (8.57%)	5 (10.0%)
Hispanic/Latino	2 (1.67%)	6 (4.35%)	2 (1.90%)	1 (2.00%)
Prefer not to answer	1 (0.83%)	0 (0.00%)	1 (0.95%)	1 (2.00%)
White	87 (72.5%)	99 (71.7%)	84 (80.0%)	40 (80.0%)
Political Party:				
Democrat	60 (50.0%)	70 (50.7%)	49 (46.7%)	10 (20.0%)
Independent	23 (19.2%)	21 (15.2%)	32 (30.5%)	17 (34.0%)
Republican	37 (30.8%)	47 (34.1%)	22 (21.0%)	21 (42.0%)
Something else - Please specify	0 (0.00%)	0 (0.00%)	2 (1.90%)	2 (4.00%)
Political Stance:				
Conservative	30 (25.0%)	37 (26.8%)	22 (21.0%)	19 (38.0%)
Extremely Conservative	17 (14.2%)	7 (5.07%)	3 (2.86%)	8 (16.0%)
Extremely Liberal	12 (10.0%)	21 (15.2%)	15 (14.3%)	1 (2.00%)
Liberal	32 (26.7%)	43 (31.2%)	37 (35.2%)	9 (18.0%)
Moderate	29 (24.2%)	30 (21.7%)	28 (26.7%)	13 (26.0%)
**Statistically significant ($p < 0.05$) predictors of respondents in group 2 as compared to those with Advanced Degrees.				

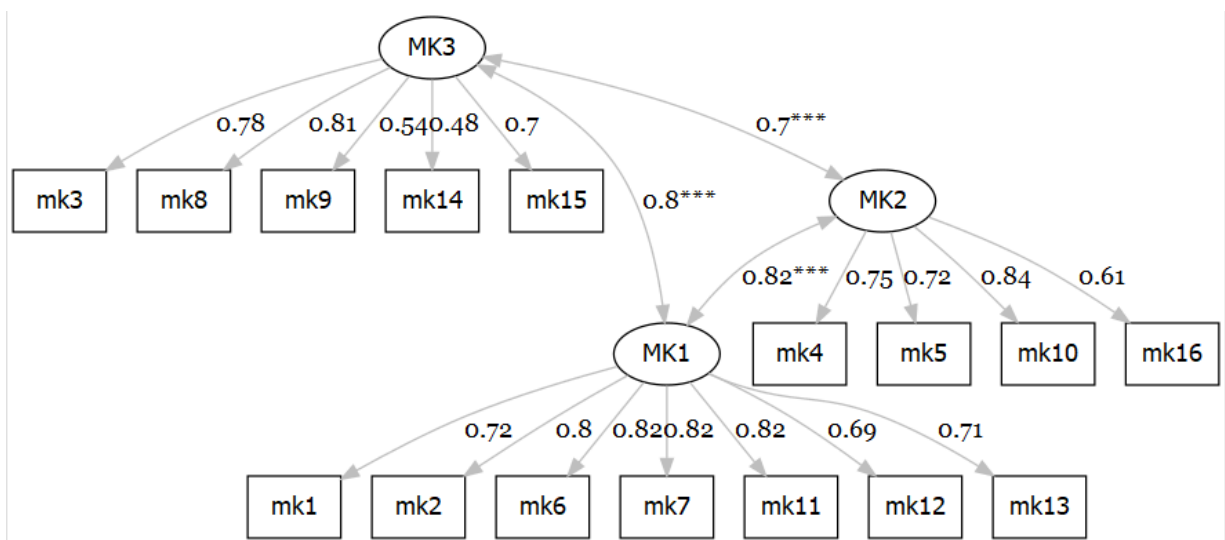
Factor Analysis

Factor analysis was used to reduce the data from the sixteen questions into a smaller number of factors (latent variables) that could be utilized to explain the observed variables. The analysis was performed using Promax Rotation and maximum likelihood as the factoring method. Results showed that the 16 items loaded onto three factors. This indicates the questions were related to each other in three distinct ways, suggesting that there were three underlying concepts or ideas being measured. The reliability of the included factors was > 0.7 as assessed by Cronbach's alpha.

Table 14: Factor Analysis

	MK 1	MK 2	MK 3
<i>mk1</i>	0.59	-0.04	0.22
<i>mk2</i>	0.38	0.32	0.17
<i>mk3</i>	-0.05	0.11	0.75
<i>mk4</i>	-0.07	0.76	0.06
<i>mk5</i>	-0.04	0.74	0.03
<i>mk6</i>	0.57	0.20	0.10
<i>mk7</i>	0.49	0.30	0.09
<i>mk8</i>	0.20	-0.12	0.75
<i>mk9</i>	-0.16	-0.04	0.72
<i>mk10</i>	-0.02	0.83	0.04
<i>mk11</i>	0.74	-0.05	0.19
<i>mk12</i>	0.94	-0.12	-0.13
<i>mk13</i>	0.73	0.17	-0.16
<i>mk14</i>	0.08	-0.00	0.42
<i>mk15</i>	0.04	0.17	0.53
<i>mk16</i>	0.12	0.57	-0.12
<i>Cronbach's α</i>	<i>0.91</i>	<i>0.81</i>	<i>0.80</i>

These factors are designated in Figure 11 by MK1, MK2, and MK3. Factor MK1 was related to the way respondents rated solutions 1, 2, 6, 7, 11, 12, and 13 on the survey. Factor MK2 was related to the way respondents rated solutions 4, 5, 10, and 16. Lastly, factor MK3 was related to the way respondents rated solutions 3, 8, 9, 14, and 15.

Figure 12: Confirmatory Factor Analysis Results

Each of the factors were also measured for correlation. According to Figure 12, MK1 and MK2 were highly correlated ($r = 0.82$, $p < 0.001$), MK1 and MK3 were highly correlated ($r = 0.80$, $p < 0.001$), and MK2 and MK3 were highly correlated ($r = 0.70$, $p < 0.001$). The three factors were highly correlated with each other at a significant level.

Table 15 indicates the themes that emerged when analyzing the content of the solutions compared to the three relevant factors. Solutions that corresponded to factor MK1 primarily addressed community and mental health. Solutions that corresponded to factor MK2 addressed firearms and regulations. Solutions that corresponded to factor MK3 addressed the media. Therefore, respondents rated the effectiveness of each of the sixteen solutions based on their mental models of community and mental health, firearms and regulations, or media.

Table 15: Factor Themes

#	<i>Proposed Possible Solutions</i>	<i>Factor</i>	<i>Theme</i>
1	Adults build relationships and mentor young people.	MK1	Community/ Mental Health
2	Encourage all individuals to develop strong skills in crisis intervention and prevention.		
6	Institutions of all kinds create a warm environment, follow trauma-informed practices that include knowledge about the signs, symptoms and impact of trauma and avoid re-traumatization of a patient.		
7	Institutions of all kinds build care teams and referral processes and train staff.		
11	Teach social emotional learning in schools.		
12	Build a stronger social safety net with adequate jobs, childcare, maternity leave, health insurance, and access to higher education.		
13	Reduce stigma and increase knowledge of mental health and open access to high quality mental health treatment; fund counselors in schools.	MK2	Firearms/ Regulations
4	Safer storage of firearms.		
5	If you see or hear something, say something.		
10	Institutions of all kinds implement situational crime prevention and anonymous reporting systems.		
16	Enforce universal background checks, red flag laws, permit-to-purchase, magazine limits, wait periods, assault rifle ban.	MK3	Media
8	Teach media literacy in schools.		
9	Limit active shooter drills for children in schools.		
14	Follow a No Notoriety protocol (this means no information is publicized about the perpetrator).		
15	Hold media and social media companies accountable for their content.		

3 Monitor our own media consumption.

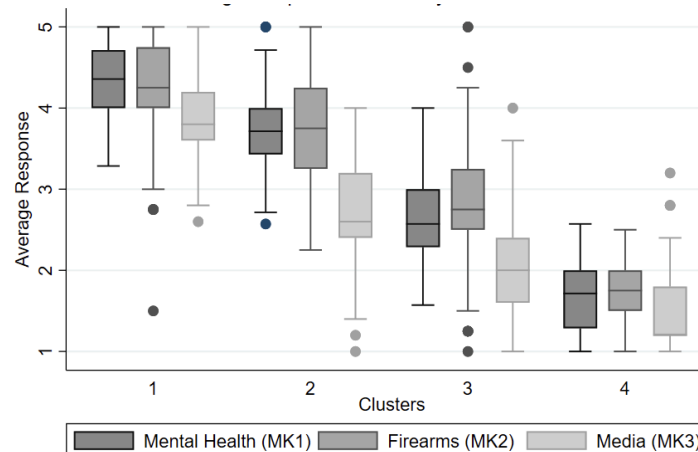
Table 16 shows the average rating (and standard deviation) of the efficacy of each of the proposed solutions according to the factors. Therefore, the average rating for Factor MK1 by Cluster 1 was calculated by finding the mean and standard deviation of all of the solutions corresponding to Factor MK1 for those respondents determined to be in Cluster 1. Though factor analysis is determined by each respondents individual patterns of responding to the solutions agnostic of the factors, this table provides a snapshot of how the clusters rated according to the factors.

Table 16: Average Response Score of Factors by K-means Clusters

	<i>Factor 1: Community/ Mental Health</i>	<i>Factor 2: Firearms/ Regulations</i>	<i>Factor 3: Media</i>
Overall	3.38(0.99)	3.42(1.04)	2.72(0.98)
K-means			
<i>1*</i>	4.30(0.47)	4.24(0.61)	3.87(0.45)
<i>2</i>	3.71(0.48)	3.78(0.62)	2.66(0.58)
<i>3</i>	2.70(0.51)	2.84(0.75)	2.08(0.59)
<i>4</i>	1.69(0.45)	1.71(0.41)	1.48(0.53)

Figure 13 below provides a clearer image of the information in Table 16. This graph indicates that Cluster 1 had the highest overall ratings by factors. This graph also shows that each of the clusters rated Factor MK3 (media) as lower than the other two factors. Lastly, Table 16 and Figure 13 show that Cluster 2 assessed Factor MK1 (community and mental health) solutions as more effective than firearms and regulations and media, but Clusters 2, 3, and 4 assessed Factor MK2 (firearms and regulations) solutions as more effective than the other two factors.

Figure 13: Average Responses by Cluster and Factors



Pairwise comparison provided the validity with which each of the sixteen questions can be grouped into the three factors. Table 17 shows that each question grouped into their corresponding factor with a high level of significance ($p < 0.001$).

Table 17: Pairwise Comparison

<i>Factor</i>	<i>Question</i>	<i>Cluster 1*</i> (<i>n=120</i>)	<i>Cluster 2</i> (<i>n=138</i>)	<i>Cluster 3</i> (<i>n=105</i>)	<i>Cluster 4</i> (<i>n=50</i>)	<i>p.overall</i>
MK1	Q1	4.31 (0.78)	3.69 (0.89)	2.81 (0.89)	2.08 (0.88)	<0.001
	Q2	4.32 (0.64)	3.65 (0.82)	2.41 (0.83)	1.7 (0.84)	<0.001
	Q6	4.23 (0.83)	3.61 (0.87)	2.4 (0.85)	1.5 (0.58)	<0.001
	Q7	4.16 (0.84)	3.52 (0.90)	2.27 (0.72)	1.58 (0.61)	<0.001
	Q11	4.36 (0.73)	3.55 (0.86)	2.5 (0.93)	1.46 (0.61)	<0.001
	Q12	4.35 (0.82)	3.85 (1.06)	3.16 (1.14)	1.62 (0.78)	<0.001
	Q13	4.39 (0.79)	4.07 (0.96)	3.36 (0.97)	1.86 (0.83)	<0.001
MK2	Q4	4.28 (0.89)	3.72 (1.10)	2.75 (1.19)	1.44 (0.61)	<0.001
	Q5	4.34 (0.88)	3.82 (0.98)	2.75 (1.08)	2.06 (0.84)	<0.001
	Q10	4.18 (0.78)	3.47 (0.84)	2.58 (0.90)	1.62 (0.57)	<0.001
	Q16	4.16 (1.08)	4.11 (1.10)	3.28 (1.36)	1.72 (0.86)	<0.001
MK3	Q3	4.08 (0.87)	2.82 (1.01)	1.9 (0.89)	1.46 (0.93)	<0.001
	Q8	4.05 (0.80)	2.78 (0.99)	2.03 (0.99)	1.24 (0.52)	<0.001
	Q9	3.2 (1.35)	1.86 (1.01)	1.66 (0.81)	1.36 (0.66)	<0.001
	Q14	3.88 (1.14)	2.54 (1.21)	2.42 (1.19)	1.76 (1.06)	<0.001
	Q15	4.12 (0.88)	3.29 (1.18)	2.38 (1.12)	1.56 (0.95)	<0.001

Table 18: Pairwise Comparison

<i>Factor</i>	<i>Cluster 1*</i> (<i>n=120</i>)	<i>Cluster 2</i> (<i>n=138</i>)	<i>Cluster 3</i> (<i>n=105</i>)	<i>Cluster 4</i> (<i>n=50</i>)	<i>p.overall</i>
MK1	0.81 (0.35)	0.25 (0.31)	-0.59 (0.33)	-1.37 (0.32)	<0.001
MK2	0.91 (0.47)	0.3 (0.45)	-0.65 (0.48)	-1.65 (0.35)	<0.001
MK3	1.13 (0.37)	0.09 (0.44)	-0.72 (0.47)	-1.44 (0.41)	<0.001

Table 18 indicates the level with which each of the clusters correlated with the three factors. Clusters 3 and 4 negatively correlated across all three factors while Clusters 1 and 2 positively correlated across all three factors. When looking at Tables 17 and 18, it is clear that Cluster 1 contains respondents that are closest to thinking systemically. Only 29% (120) of respondents consistently rated the empirically-based solutions as Moderately Effective (4.15). Therefore, 71% of respondents contained in Clusters 2, 3, and 4, did not think about the proposed solution systemically.

Overall, the research demonstrates that when proposed with an empirically-based set of policy solutions that address a wicked problem, the majority of the people do not recognize that all solutions are essential to effectively address the issue. Instead, we see that approximately only a quarter of people think somewhat systemically. Moreover, the analysis demonstrates that people tend to rate or assess possible solutions according to apriori beliefs - the three factors - about broader issues instead of specific solutions in the specific systemic context. For those who think systemically, these factors are highly correlated with each other, but that correlation becomes less visible as the level of systems thinking decreases.

Discussion

The “What’s the Crisis? (2)” survey findings indicate that despite understanding humans as a primary cause of today’s most pressing crises, there tends to be a prevailing overemphasis on government as the main entity responsible for addressing and solving crises, neglecting the significance of other institutions and the crucial role of individuals within them.

The “Solving Problems” survey findings further illustrate the failure to recognize the need for a web of solutions and a tendency to gravitate towards a few recommendations when addressing wicked problems. The solutions presented in *The Violence Project: How to Stop a Mass Shooting Epidemic* [37] offer a comprehensive and empirically-based approach to addressing a complex problem with interconnected causes, representing a true web of solutions. In our interview with Dr. Densely he stated “You have to do all of them... if you want to truly address all aspects of the problem... Listing them in order... wouldn't necessarily work because these things are all happening simultaneously, and they're interconnected and intertwined now” (refer to Appendix D). However, when presented to a representative sample of the United States population, a lack of consensus on how to solve the problem becomes evident. Although there isn’t consensus on which solutions are perceived to be the most effective, there is consensus that some solutions are more important than others - few respondents recognized the necessity for all of the solutions.

Only 29% of respondents demonstrated some degree of systemic understanding - not a single respondent rated all the listed solutions as “Extremely effective,” the ratings that would indicate an understanding of a web of causality that drives the emergence of mass killings. Someone with an understanding of complexity and wicked problems, with the training to recognize and resist human tendencies for LAMO thinking patterns, should rate all of the listed solutions as extremely effective. These findings demonstrate that the majority of the general public lacks training in systems thinking.

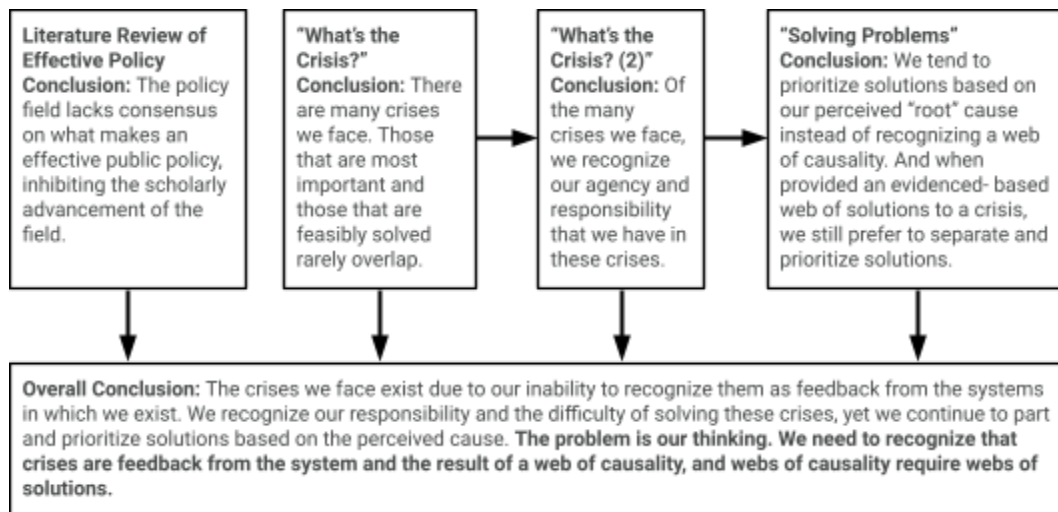
Instead, respondents exhibited a range of perceptions regarding the effectiveness of the solutions. Approximately 29% (Cluster 1) of the 413 respondents believed that 14 of the 16 solutions would be moderately effective, while 12% (Cluster 4) considered 14 of the 16 solutions to be largely ineffective, with various viewpoints falling in between. Factors analysis revealed there were respondents who perceive solutions pertaining to firearms and their regulation as the key to addressing mass shootings. Others focus on solutions relating to media. Lastly, there were those who perceive solutions pertaining to community and mental health issues as the key solutions. The significance of these factors lies not in the specific opinions about each factor, but in the prevailing thinking patterns observed. Despite differing perspectives on the “root cause” of mass shootings, these differing viewpoints highlight prevailing

thinking patterns, including binary thinking and the tendency to identify a singular cause rather than recognizing the interconnectedness of multiple factors and the need for comprehensive solutions. This discrepancy between respondents' perceived importance of solutions (3.18[1.32]) and their actual effectiveness underscores a fundamental flaw in how we perceive and address complex problems. Our dominant problem-solving approach involves identifying a singular root cause and implementing solutions individually, disregarding the volatile, uncertain, complex, and ambiguous nature of reality. Moreover, we tend to prioritize and implement solutions sequentially, neglecting the interdependencies among them. When a solution fails, it is often attributed to inherent ineffectiveness rather than recognizing the failure of implementing it in isolation.

Based on these findings, it is evident that our flawed thinking leads to policies that are not aligned with our intended outcomes. Providing more comprehensive systems thinking education is crucial to achieving greater understanding and alignment between the public and academic research. Such a shift in thinking will be a critical step in aligning the public's mental models with reality, fostering a better understanding of the root causes of complex issues, and promoting acceptance of complex solutions over simplified ones.

Figure 14 visually summarizes the conclusions from our literature review on effective policy, the original "What's the Crisis?" study [1], our follow-up survey, "What's the Crisis? (2)", and the "Solving Problems" survey, as well as our overall takeaways for this study.

Figure 14: Summary of Study Conclusions



Recommendations

Based on the aforementioned findings, we propose the following four recommendations:

- (1) **Recognize wicked problems as feedback from the system:** Wicked problems are characterized by their ambiguity, dynamic nature, and the presence of multiple, often conflicting, perspectives.

These characteristics make them resistant to our traditional ways of solving problems. Instead of seeking to identify a root cause or becoming overwhelmed by the complexity of the problem, we should recognize wicked problems as *feedback* indicating a misalignment between our mental models and reality. This shift in perspective presents an opportunity to approach these wicked problems differently, recognizing them as outcomes of complex realities. What wicked problems tell us is that our approaches to solving them thus far have been insufficient because our mental model of the issue is not adequately approximating reality. Instead of trying to fix a problem we are not seeing clearly, we first need to adjust our mental models to better approximate reality. By using this feedback to inform and adjust our mental models, we can more effectively design policies and solutions to address the underlying causes of the issue.

- (2) **Understand that webs of causality are inherent in wicked problems:** Moving away from the concept of “root causes,” policymakers should seek to understand the ways in which multiple causes intersect and interact to create wicked problems. Relying on isolated approaches that target one cause and quickly switching to alternatives when faced with failure impedes progress. Policymakers need to resist the inclination to prioritize singular approaches and instead implement multiple solutions concurrently that address multiple causes. Policies should be critically examined to identify additional solutions that can be pursued simultaneously.
- (3) **Apply an agent-based approach:** Wicked problems are complex issues that result from the dynamics of Complex Adaptive Systems (CAS). CASs consist of independent agents following simple rules that yield emergent properties that shape the behavior of the system. Solutions employing an agent-based approach (ABA) to tackle wicked problems, prioritize understanding the interactions of individual agents within the system and how they collectively shape the behavior of the system [38]. Policymakers can develop more effective policies by targeting and leveraging the agency of individuals within the system.
- (4) **Prioritize systems thinking education in policy programs:** To equip future policy professionals with the necessary skills and mindset, systems thinking education must become central to policy programs. Currently, very few schools offer systems thinking courses in their public affairs programs. Given the complexity of wicked problems in our volatile, uncertain, complex, and ambiguous (VUCA) world, linear, analytical, and reductionist thinking alone is insufficient. By transforming policy education, we can challenge prevailing flawed thinking patterns and foster a new generation of policy professionals who are better prepared to address the complex challenges of our time.

Conclusions

In summary, our research highlights:

1. The need for a common definition of effective public policy applicable to both simple and complex issues, supported by empirical data, to enhance the scholarly significance of the field. Implementing these suggestions would improve the validity and reliability of policy formation methods, advancing the policy community as a whole.

2. The findings from the "What's the Crisis? (2)" survey and the "Solving Problems" survey shed light on our perception and approach to complex problems. While respondents recognize the role of humans in causing some of our most pressing crises, there is a tendency to look to government institutions to solve our wicked problems, overlooking the significance of other institutions and the role of individuals in these systems. When presented with a web of solutions, people fail to recognize the importance and need for all of the solutions to be implemented, thus demonstrating that most respondents have a tendency towards linear and binary thinking. The prevalence of LAMO thinking leads us to seek out the panacea for complex problems. It emphasizes the need to recognize wicked problems as feedback from the system, indicating a misalignment between our mental models and real-world systems. This disconnect between perceived and actual effectiveness reveals a fundamental flaw, leading to policies misaligned with intended outcomes.
3. To address these issues, recognizing wicked problems as feedback from the system is crucial. Systems thinking, specifically DSRP [39], can help better align our mental models with reality and identify the webs of causes inherent in wicked problems. By applying an agent-based approach to develop complementary webs of solutions, we can more effectively address the wicked problems facing society.

To address this, comprehensive systems thinking education is needed to bridge the gap, particularly in policy programs to cultivate policy professionals capable of tackling complex challenges.

Cabrera and Cabrera, et. al., have demonstrated the patterns of cognition that cut across disciplines [40] and identified the specific skills involved in systems thinking [41], [42], [43], [44], [45]. They have shown the effectiveness of systems thinking in enhancing cognitive complexity [46] and have begun a research agenda on its application to complex systems in policy analysis [38]. In other words, the research supporting systems thinking is well-established, and the tools to teach it are readily available. What we require now is a cultural shift where individuals across the education and policy systems recognize and prioritize the importance of systems thinking, advocating for its inclusion in curricula, particularly for future policy makers. By embracing a more holistic and interconnected perspective, we can ensure that the mental models guiding modern policy align more closely with reality, and lead to our desired outcomes. While our findings represent an important step in understanding the role of systemic thinking in achieving policy goals, further research on the influence of political polarization in shaping perceptions of solutions to wicked problems would be a compelling area to explore in more depth.

Appendices

Appendix A: Literature Summaries

Policy Design and Implementation

Crow et al. [47] analyze policy learning in the context of COVID-19 pandemic. Their study examines how policies evolved over the course of the pandemic, whether those evolutions are examples of policy learning or a singular event. This case study examines how different policies that were enacted during the pandemic varied across states, and how the dynamics of policy learning change during disasters.

Makse & Volden [31] look at a collection of innovations applied to criminal justice policy between 1973-2002. The attributes of the policies affected the likelihood of their adoption, with complexity and compatibility with current practices affecting adoption.

Davies [48] discusses the importance of evidence-based policies and how evaluations can help overcome barriers in implementing those policies. Davies utilizes a model that suggests evidence can be used in multiple ways: instrumental, conceptual, and symbolic. They apply the model to multiple cases in the UK, addressing how obstacles can be overcome in getting research evidence included in policy and practice.

Knudson [49] discusses the process that created California's Local Control and Accountability Plan (LCAP). They note this as an example of this traditional approach to policy development, in which key stakeholders were not consulted and recommend ways to include important perspectives.

Adom [50] examines biodiversity schemes at different countries and identifies successful approaches to incorporating local and indigenous knowledge which has been proven to result in better biodiversity policies.

Kørnøv & Thissen [51] discuss the impact of real decision-making processes, cognitive limitations, behavioral biases, ambiguity, and variability of preferences and norms, distribution of decisions-making over actors, and time, and the notion of decision making as a process of learning and negotiation.

Heikkilä & Andersson [52] focus their research on Institutional Analysis and Development (IAD), a generally accepted and applied framework for policy design and analysis, and the process of getting institutions to change. They go into detail about the interaction between institutions and individual actors to adopt policy.

Auld et al. [53] discuss "super wicked" problems in their analysis, and how policy can be developed to address them. First, similar to requirements to address the climate crisis, policy makers must establish and maintain durable policy objectives. Second, in contrast to climate, management responses must always

allow for swift changes in policy settings and calibrations given rapid and evolving knowledge about a particular disease's epidemiology.

Hoppe et al. [32] explore the properties of predictable processes in policy formulation, through 15 case studies conducted in Dutch departments.

Weaver [54] focuses on the 1st and 2nd order mechanisms that lead to desired behavioral outcomes and the extent to which reverse engineering is an effective strategy. The findings and framework are applied to retirement savings policies in households, and how the government can incentivize more savings.

Ingraham [55] analyzes the factors of what makes a good policy design. They do not provide a framework but discuss the need for stressing the design stage with policy formation.

Pagliocca & Nickerson [56] provide an overview of crisis response initiatives implemented by school districts following traumatic events, including school violence. They then examine state legislation and other policies, followed by a discussion of the advisability of such mandates, and evaluate school crisis responses.

Plomien [57] explores Poland's child-care policy through a feminist lens. The paper discusses how gender is a lens through which people develop policies and the effects are overlooked, which subsequently results in inefficient and unjust policies that perpetuate gender inequality.

Bazzan et al. [58] examine the gap between sustainable governance and policy performance. The paper asks what forms of executive governance are most conducive to successful social, environmental and economic performance, and determines that accountability, capacity and media conditions are seen to have an effect on successful outcomes.

Howlett [59] analyzes the policy design stage and argues that the current approach to designing policies needs an expanded perspective of the key tools to use to achieve goals. They sum up the design stage as requiring that the policy's aims, objectives, and targets be clearly defined, tools and implementation preferences be consistent, and that objectives and tools be congruent.

Howlett & Rainer [60] state that "while policy designs can and should be considered in the abstract, understanding how policy change processes create and modify mixes is critical to evaluating the chance of success for any particular policy mix to attain its goals once put into practice." Overall, the authors discuss that there is a need to assess the potential for policy tools in achieving their goals efficiently and effectively.

Vesely [61] discusses how policy design in the modern context should prioritize equipment designers with the system tools. They must look at policies from different perspectives, not be quick to assume what the problem is but rather understand how the system(s) operate and they must understand that public opinion from all levels of stakeholders is crucial to the process.

Head [33] discusses how political and ideological factors often undermine evidence-informed practices,

and interaction and brokering across organizational boundaries are crucial.

Andrews [62] creates a term "successful failure" in regards to policy; and discusses how policy is often designed for low-level short term success, but long-term failure. They discuss that successful failures are endemic to public policy work, and contribute to cycles of near-run success leading to future failures, and ultimately never solving problems.

Wolman [63] develops a framework for policy-makers to ask during policy formulation. They attempt to provide a framework that helps explain and understand overall policy performance. The framework breaks into the formulation process and the carrying out process, and prods policymakers to make informed decisions.

Park et al. [64] examines public policy in Korea and explores the concept of "legitimacy," or the extent to which public policy is made legitimate by elected and unelected officials and how that influences its success.

Linder & Peters [65] lay the groundwork for policy design that includes causation, evaluation and instrumentation. By focusing on a policy-design theory with these components, the authors state that we can make up for short-comings in policy development that have waited for robust macro-level social theories to come along.

Ahlqvist et al. [66] present a specific policy design approach with example case studies. Innovation policy roadmapping (IPRM) is introduced as a framework for connecting research and development outcomes with broader policy contexts and future-oriented policy formulation. The study delves into the methodological underpinnings of IPRM and highlights its policy rationale, through applications in two case studies. The article concludes by evaluating the policy implications arising from the adoption of the IPRM methodology.

Shastri et al. [67] discuss a specific policy design approach with example case studies. This paper introduces the COVID-19 Policy Evaluation (CoPE) tool, an agent-based modeling framework that allows researchers and policymakers to anticipate the relative consequences of policy choices. Specifically, this framework sheds light on how policy features and behavioral responses impact the effectiveness and fairness of policy responses during unexpected events. Their findings reveal that while implementing policies early can yield significant results, the timing's impact is influenced by other policy aspects such as duration, target audience, and societal factors like trust and compliance. They demonstrate that even policies with higher overall effectiveness can disproportionately affect vulnerable populations.

History of Policy

Almeida & Báscolo [68] describe the main theoretical approaches to explain or back the relationship between the production of scientific knowledge and its use in policy formulation and implementation.

Linder & Peters [69] discuss how errors of policy should not be seen after the fact but that flaws start with the design process. Instrument match for policy tools is an important aspect of the design process. At the

time this article was written, there was not a universal tool for policy design although an argument is made that soundness of an instrument can be overridden when an instrument is applied to the right context. They end with saying how there is a tradeoff between precision, accuracy and reliability with cost.

Schneider & Ingram [70] focus on the behavioral dimensions of policy tools, so that political scientists can better understand the conditions under which target populations will contribute to preferred policy outcomes.

Howlett & Mukherjee [71] discuss that there are non-design and design oriented aspects to policy development, they are both at opposite ends of a spectrum of the design process. There are pros and cons to both that policy makers should be aware of. They reinforce the notion that in order to have the capacity to do good design practices, decision-makers must have the desire to put in the effort and policy is influenced by context.

Fitzgerald et al. [72] discuss how policy success stems from the implementation of effective policies, which, in turn, are a result of informed decision-making. To shed light on the factors that contribute to favorable or unfavorable decisions, they propose a framework that considers various conditions. Drawing on extensive literature, they contend that institutions, interests, and ideology interact to create incentives that influence outcomes and shape the information gathering and prioritization processes. This can introduce biases that lead decision-makers to choose suboptimal courses of action, while in other cases, the absence of bias allows for successful policy choices to be made.

Howlett [35] draws lessons from both the 'old' and the 'new' design work to establish several basic criteria for effective design and designing. Lessons from these studies fall into two categories: those dealing with matching design activity to the context of policy-making and those which focus on the character of the tools deployed in a design.

Howlett et al. [73] review the changes in policy approaches over time. Their research on design orientation approach to policy needs to be putting principles of design quality in complex multi-tiered mixes, understanding the context and evolution of where policies are designed and exploring the different processes associated with them.

Stakeholder/Personal Engagement

Dermont et al. [74] present a framework for enhancing the understanding of social acceptance. Recognizing the significant influence of the policy-making stage and specificity on the response towards renewable energy technologies (RET) and the resulting processes, they outline three crucial steps to consider when designing research that incorporates social acceptance: defining the object and context under examination, identifying the relevant actors involved, and examining the roles they assume. The framework takes a political science perspective and focuses on the decision-making and implementation of future policies by political actors.

Otte [75] presents an integrated decision-making model for climate action. Drawing from diverse fields within climate change literature, the framework identifies crucial conditions (stages) that shape individuals' decisions regarding climate action. To achieve a shift toward a low-carbon society, a diverse range of climate policies is required, addressing various stages of the decision-making model. These policies should include short-term measures such as incentives and carbon pricing, as well as long-term strategies that foster social change by addressing deeper societal values, redefining concepts of social well-being and happiness.

Wolsink [76] examines the contentious nature of constructing new infrastructure. It presents a comparative study of three environmental policy domains in the Netherlands, all of which involve justifying the building and placement of infrastructure facilities. These projects are typically deemed crucial for environmental policy and are intended to serve sustainability objectives. They are believed to serve the (declared) interests of the public, while the negative impacts or risks, primarily affecting environmental values, are concentrated at a smaller scale, such as local communities.

Cheng & Tsou [77] aim to develop a Mitigation Policy Acceptance Model (MPAM) to analyze the behavioral intention towards seismic risk mitigation strategies. Drawing from Dual Processing Theory, the core variable in MPAM is affective, which encompasses two types of thinking processes. Additionally, variables including risk perception, trust, and responsibility are incorporated into MPAM based on theories and prior research. The case study focuses on the residential seismic strengthening policy implemented in Yongkang District of Tainan. The results of the model fit test confirm the validity of the MPAM framework, demonstrating that individuals engage both thinking modes during risky decision-making processes. These findings aim to offer valuable insights for government risk communication strategies.

de Groot & Schuitema [78] discuss how a policy can be made acceptable, through a combination of coercive and behavioral change. They found that acceptability decreased when it was communicated that a minority, rather than a majority, of the public supported a particular policy. The study also identified two interaction effects. Firstly, push measures, which aimed to discourage high-cost behavior, were perceived as particularly unacceptable. Secondly, when individuals perceived a weak social norm, push measures were less acceptable. On the other hand, when push measures targeted low-cost behavior or when it was evident that a majority of people supported the policy, the environmental policy became almost as acceptable as pull measures. These findings indicate the importance of presenting push measures in a manner that minimizes public opposition, potentially transforming the unpopular into the popular.

Mintrom & Luetjens [79] explore policy through the lens of public value framework. They argue for fostering public value benefits for the design, implementation and evaluation stages of policy.

Butcher et al. [80] identify the necessary attributes of successful collaborations by examining five case studies that provide important insights into sound collaborative practice.

Ahlers & Schubert [81] analyze successful policy implementation examples in China. Through an examination of four cases related to the "Building of a New Socialist Countryside," the article demonstrates how effective policy implementation can arise from factors that are often considered

obstructive in the study of local governance, such as performance and cadre evaluation, limited financial resources, restricted public participation, and a focus on established models.

Park et al. [82] discuss the application of public information campaigns for public policy, finding that messages focused on high-level (why-laden) features were more persuasive when the messages were framed in terms of socially distant entities (the planet/Earth), while messages focused on low-level (how-laden) features were more effective when asking participants to make judgments about their proximal entities (their country/local community).

Lee & Kwon [83] examine the potential of risk communication in addressing the issue of low public acceptance of high-risk facilities by focusing on risk perception. The findings of this study suggest that risk communication can be an effective approach to managing risk perception and enhancing policy acceptance. They state that it is crucial to develop strategies for risk communication that foster active participation of the public alongside governmental bodies and energy providers in the decision-making process. Such collaborative approaches can facilitate effective risk communication and ultimately contribute to improved public acceptance of high-risk facilities.

Swim & Geiger [84] found that participants in their studies showed a preference for policies that focus on changing the energy supply by transitioning to renewable energy sources, rather than policies that aim to reduce energy demand through energy efficiency measures. Participants also preferred policies that utilized incentives rather than disincentives, particularly when the policies targeted individuals as opposed to businesses. Interestingly, participants exhibited greater tolerance for the use of disincentives when they were applied to businesses rather than individuals. Overall, participants' preferences for specific policy types were shaped by their expectations of environmental effectiveness, economic benefits, and social impacts, highlighting the importance of considering these factors when designing and implementing energy-related policies.

Lalott et al. [85] find that there is a broad consensus among individuals with diverse political beliefs regarding the effectiveness of certain actions to address environmental challenges, with a particular emphasis on strong actions like altering consumption patterns. This has important implications for policymakers, environmental campaigns, and media representations of environmental issues. Instead of solely highlighting the problems at hand, efforts should focus on promoting actions that enjoy widespread support. By emphasizing the objectively effective measures that the public is willing to endorse, policymakers have a responsibility to develop and implement policies aligned with these preferences.

Eriksson et al. [86] studied the acceptability of different transport policy measures. They developed a model that combined the value-belief-norm theory with policy-specific beliefs, such as perceived fairness and perceived effectiveness. Results revealed that pull measures were perceived as effective, fair, and acceptable, whereas the push measure and policy packages were seen as relatively ineffective, unfair, and unacceptable. The proposed model received support for the evaluated measures, with problem awareness demonstrating a direct impact on acceptability for the pull measures, while personal norms directly influenced acceptability for the push measure and the two policy packages.

Oe & Yamaoka [87] approached the relationship between information senders and receivers through the lens of citizen behavioral change, with a specific focus on the nudge effect. The nudge effect, in this context, refers to the ability of policymakers to effectively communicate and prompt behavioral changes in citizens who receive the information. To shed light on citizens' spontaneous incentive structure, the authors present a conceptual framework that emphasizes the need for collaboration between citizens and policymakers, to enhance the effectiveness of social policies. The proposed model aims to serve as a valuable discussion framework for researchers and practitioners involved in human resource training and system development related to information dissemination. Furthermore, the model has the potential to facilitate in-depth discussions on topics that contribute to improving information transfer and communication within organizations.

Systemic Approaches

Corbin [34] studies the effects of policies in disasters. The recovery process tends to be uneven, perpetuating social vulnerability that existed prior to the event and resulting in limited political power for affected populations. This study suggests that such large-scale events can serve as an opportunity to address these challenges and enhance social, economic, political, and environmental conditions for affected communities during the recovery phase. The key proposition is to involve advocates representing traditionally marginalized community members in the recovery efforts, thereby empowering these communities and fostering more equitable outcomes.

Wilson et al. [88] conducted a case study on Connecticut's education reform. They attribute Connecticut's success to their interconnected and comprehensive approach including: wide range of stakeholder engagement, tiered teacher licensure and an iterative, steady, long term perspective.

Tickner & Geiser [89] explores various approaches and case studies related to alternatives assessment, and we also consider the potential for integrating this principle into environmental policy. Our argument is that placing greater emphasis on alternatives assessment can significantly enhance decision makers' ability to make precautionary choices, drive innovation towards sustainable production, and more effectively assign responsibility to those creating risks. They state that a shift towards a solutions-based approach is essential for transitioning from a problem-centric environmental policy to one that focuses on proactive solutions. They conclude that achieving sustainable production requires a shift in our environmental protection mindset, moving away from assessing the severity of problems and towards exploring alternatives to problematic activities while creating conditions for a more sustainable future.

Atkinson et al. [90] address the shortcomings of conventional analytic tools used in evidence-informed policy decisions for complex issues. It introduces an alternative policy analysis tool that integrates diverse sources of evidence and provides a virtual testing platform for policy alternatives. The aim is to design solutions that are efficient, effective, and equitable. The case of suicide prevention in Australia is presented as an example to illustrate the limitations of existing tools in adequately informing prevention policies, and the potential value of the new policy analysis tool is discussed.

Blomkamp [91] presents a new practice framework for systemic design in public policy and social innovation, drawing upon the author's expertise as a researcher, evaluator, practitioner, and educator in the field of public policy and human services. The framework encompasses five core domains: principles, place, people, process, and practice. To illustrate the relevance of the practice framework, a case study of a design-led approach to a community services policy in New Zealand is presented. The case study examples highlight both the benefits and challenges associated with systemic innovation and participatory policy design.

Cockerill et al. [92] argue that there exists a spectrum of possibilities for applying collaborative modeling in the policy arena, ranging from purely academic endeavors to full-fledged collaborations involving subject matter experts, the general public, and decision makers. Similarly, there are various options for incorporating collaboration within the policy process itself. They find that participants in collaborative modeling projects develop a deeper understanding of the complexity underlying the addressed policy issue, achieve greater consensus on root problems, and gain a nuanced appreciation for the inherent uncertainty in data and methods when studying complex systems. They conclude that the attributes of collaborative modeling make it an appealing choice for enhancing the decision-making process and improving on-the-ground policy decisions.

The OECD drafted a paper titled "The Design and Implementation of Mission-Oriented Innovation Policies" [93] that systematically investigates the challenges and opportunities associated with MOIPs at both the initiative and country levels. By doing so, it enhances the understanding of the diverse approaches governments employ in designing, funding, and coordinating MOIPs. Additionally, it expands the range of options available for enhancing or initiating this policy approach.

Sanderson [94] contends that it is crucial to reexamine the underlying principles that shape our understanding of evidence-based policy and transcend the realm of instrumental rationality. Instead, we should embrace two key pillars: our evolving understanding of complex adaptive systems and insights from a pragmatic philosophical standpoint, particularly the ideas of John Dewey regarding social scientific knowledge and its role in guiding action to address social problems. This perspective leads to a notion of "intelligent policy making" that places policy learning at its core.

Samnakay [95] discusses how the development and implementation of strategic policies by governments are crucial for addressing long-term, cross-sectoral challenges that require coordinated efforts across different levels of government. However, the process of developing and implementing national strategic policies in Australia lacks clarity and has received limited attention in the literature. This paper aims to fill this gap by establishing a foundation for understanding the characteristics of strategic policies and the approaches used in their development. The study compares five national policies, namely National Competition Policy, National Strategy for Ecologically Sustainable Development, Strategic Roadmap for Australian Research Infrastructure, Australia in the Asian Century, and National Food Plan, and discusses their key features. An analytical framework is constructed, and important attributes of strategic policies are identified.

McConnell [96] presents a framework that aims to capture the diverse outcomes that indicate the level of success or failure of a policy. Drawing on existing literature on policy evaluation, public value, best

practices, political strategy, and policy outcomes, the framework identifies areas for improvement and addresses existing gaps. The framework conceptualizes policy within three realms: processes, programs, and politics. Policies can exhibit varying degrees of success or failure in each realm, falling along a spectrum that includes success, resilient success, conflicted success, precarious success, and failure. The paper concludes by examining contradictions between different forms of success, including situations where a policy may be considered politically favorable but lacks effectiveness in achieving its intended goals.

Colvin et al. [97] discuss the strong argument for allocating resources to support local-level systemic innovation through social-learning praxis design approaches and fostering learning processes based on well-contextualized case studies. However, they argue that policymakers should also invest in social learning as an additional governance mechanism that complements systemic innovation for sustainable development.

Battistoni [98] seeks to position Systemic Design (SD) as a promising design model for achieving sustainability by introducing a structured process called Holistic Diagnosis (HD). By building on the concepts of design for sustainability and systems thinking, this study conducted multiple case-study analyses to evaluate the effectiveness of HD. The findings indicate that HD has the capacity to transcend design limitations in various domains, including industrial production, local communities, and policy-making. Through an iterative process of assessment, research, data collection, visualization, and interpretation, HD enables a deeper understanding of complex environments. As a tool, this framework empowers designers to tackle problem framing in intricate scenarios and generate innovative and transdisciplinary solutions for a sustainable future. It fosters horizontal dialogue among all stakeholders involved in the process.

Giraldo Nohra et al. [99] investigates the influence of systemic design-driven circular economy policy design processes and their potential to facilitate innovative and effective policy planning for circular transitions in EU regions. Drawing on recent advancements in systemic design as an approach to addressing complex issues, as well as a literature review on systems thinking, design thinking for sustainable development, and policy design, the research focuses on identifying existing barriers to circular economy implementation. The discussion narrows down to a specific case study, the Interreg Europe RETRACE project, which applies the systemic design methodology to guide five European regions towards circular economy practices. The study provides a comprehensive analysis of how systemic design can address current obstacles and generate short, medium, and long-term policy strategies for transitioning European regions towards a circular economy.

Appendix B : “What’s the Crisis? (2)” Survey

STML2023: What's the Crisis?

Let's Get Started

1. Statement of Consent: *

☐ I have read the information above and consent to take part in this study.

2. The most important crisis humanity currently faces is... *

3. In a few words, if you were to identify the *primary cause(s)* for the crisis you identified in the previous question, what would it/they be? *

4. Who is primarily responsible for solving this crisis? (Select all that apply) *

- ☐ Charities
- ☐ Churches/Religious Organizations
- ☐ Corporations
- ☐ Individuals
- ☐ Local Communities
- ☐ Local/State Government
- ☐ National Government
- ☐ Media organizations
- ☐ Non-profit organizations
- ☐ Research Institutions
- ☐ Schools
- ☐ Other - Write In (Required)

*

Ranked Crises

5. Select your top 5 crises from the list below and rank them, in order of **IMPORTANCE** (1=MOST IMPORTANT, 5=LEAST IMPORTANT)

****MOBILE USERS: tap items in order of MOST to LEAST important (tap again to de-select an item). ***

Drag items from the left-hand list into the right-hand list to order them.

Crises	Rank
Reliable Information/Data for Decision-Making Not Available	
Lack of Access to Quality Education	
Lack of Access to Quality Health Care	
Corporate Influence on Governance	
Political Corruption	
Election Reform	
Lack of Environmental Sustainability	
Health Epidemics	
Human Disconnection/Isolation	
Discrimination	
Loss of Civil Liberties	
Mass Killings (e.g., school shootings, etc.)	
Misinformation in the Media	
State of the Economy	
Wealth Inequality	

7. Are there any other crises you are concerned about that were not on the previous list in Questions 5 & 6? If so, please provide them - if not, please write N/A to indicate you don't have any additions. *

8. Any other comments you'd like to make are welcome here:

Tell us a little about yourself.

9. What is the highest degree or level of education you have completed? *

- ☐ Less than high school
- ☐ Graduated high school
- ☐ Trade/technical school
- ☐ Some college, no degree
- ☐ Associate degree
- ☐ Bachelor's degree
- ☐ Advanced degree (Master's, Ph.D., M.D.)

10. What gender do you identify as? *

- ☐ Male
- ☐ Female
- ☐ Gender Variant / Non-conforming
- ☐ Other - Write In
- ☐ Prefer not to answer

11. What is your age? *

- ☐ 17 or younger
- ☐ 18 to 24
- ☐ 25 to 34
- ☐ 35 to 44
- ☐ 45 to 54
- ☐ 55 to 64
- ☐ 65 to 74
- ☐ 75 or older

12. Please specify your race & ethnicity (check all that apply). *

- ☐ Asian
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ Black/African-American
- ☐ White
- ☐ Hispanic/Latino
- ☐ American Indian/Alaska Native
- ☐ Other - Write In
- ☐ Prefer not to answer

Appendix C: Solving Problems Survey

Solving Problems 2023

Let's Get Started

1. Statement of Consent: *

☐ I have read the information above and consent to take part in this study.

(untitled)

2. How **concerned** are you with the occurrence of mass killings? *

Extremely
Concerned

☐

Moderately
Concerned

☐

Somewhat
Concerned

☐

Slightly
Concerned

☐

Not at all
Concerned

☐

3. In your opinion, how **solvable** is the issue of mass killings? *

Extremely
Solvable

☐

Moderately
Solvable

☐

Somewhat
Solvable

☐

Slightly
Solvable

☐

Not at all
Solvable

☐

4. Please explain the rating you gave in Question 3 about solvability. *

5. Please rate how **effective** you believe each possible solution would be in solving the issue of mass killings. *

	Not At All Effective	Slightly Effective	Somewhat Effective	Moderately Effective	Extremely Effective
Follow a No Notoriety protocol (this means no information is publicized about the perpetrator)	☐	☐	☐	☐	☐
Enforce universal background checks, red flag laws, permit-to-purchase, magazine limits, wait periods, assault rifle ban.	☐	☐	☐	☐	☐
Safer storage of firearms.	☐	☐	☐	☐	☐
Institutions of all kinds create a warm environment, follow trauma-informed practices that include knowledge about the signs, symptoms and impact of trauma and avoid re-traumatization of a patient.	☐	☐	☐	☐	☐
Institutions of all kinds implement situational crime prevention and anonymous reporting systems.	☐	☐	☐	☐	☐
Build a stronger social safety net with adequate jobs, childcare, maternity leave, health insurance, and access to higher education.	☐	☐	☐	☐	☐
Teach social emotional learning in schools.	☐	☐	☐	☐	☐
Monitor our own media consumption.	☐	☐	☐	☐	☐
Institutions of all kinds build care teams and referral processes and train staff.	☐	☐	☐	☐	☐
Teach media literacy in schools.	☐	☐	☐	☐	☐

Reduce stigma and increase knowledge of mental health and open access to high quality mental health treatment; fund counselors in schools.	☐	☐	☐	☐	☐
Adults build relationships and mentor young people.	☐	☐	☐	☐	☐
If you see or hear something, say something.	☐	☐	☐	☐	☐
Hold media and social media companies accountable for their content.	☐	☐	☐	☐	☐
Limit active shooter drills for children in schools.	☐	☐	☐	☐	☐
Encourage all individuals to develop strong skills in crisis intervention and	☐	☐	☐	☐	☐

(untitled)

6. How **concerned** are you with the occurrence of wildfires? *Extremely
Concerned☐Moderately
Concerned☐Somewhat
Concerned☐Slightly
Concerned☐Not at all
Concerned☐7. In your opinion, how **solvable** is the issue of wildfires? *Extremely
Solvable☐Moderately
Solvable☐Somewhat
Solvable☐Slightly
Solvable☐Not at all
Solvable☐

8. Please explain the rating you gave in Question 7 about solvability.*

9. Please rate how **effective** you believe each possible solution would be in solving the occurrence of wildfires.*

	Not At All Effective	Slightly Effective	Somewhat Effective	Moderately Effective	Extremely Effective
Develop an effective emergency response system and test it.	☐	☐	☐	☐	☐
Strengthen stakeholder coordination and preparedness.	☐	☐	☐	☐	☐
Build more robust water and power systems.	☐	☐	☐	☐	☐
Individual/local prevention measures.	☐	☐	☐	☐	☐
Implement existing fire management techniques.	☐	☐	☐	☐	☐
Refocus land use policies and incentives for better land-use planning and management.	☐	☐	☐	☐	☐
Plan for emergency shelters.	☐	☐	☐	☐	☐
Plan mandatory evacuations.	☐	☐	☐	☐	☐
Invest in fire suppression and prevention.	☐	☐	☐	☐	☐
Raise public awareness.	☐	☐	☐	☐	☐
Provide holistic support to survivors of wildfires.	☐	☐	☐	☐	☐
Improve wildfire data collection and analysis.	☐	☐	☐	☐	☐

Tell us a little about yourself.

10. What is the highest degree or level of education you have completed? *

- ☐ Less than high school
- ☐ Graduated high school
- ☐ Trade/technical school
- ☐ Some college, no degree
- ☐ Associate degree
- ☐ Bachelor's degree
- ☐ Advanced degree (Master's, Ph.D., M.D.)

11. What gender do you identify as? *

- ☐ Male
- ☐ Female
- ☐ Gender Variant / Non-conforming
- ☐ Other - Write In
- ☐ Prefer not to answer

12. What is your age? *

- ☐ 17 or younger
- ☐ 18 to 24
- ☐ 25 to 34
- ☐ 35 to 44
- ☐ 45 to 54
- ☐ 55 to 64
- ☐ 65 to 74
- ☐ 75 or older

13. Please specify your race & ethnicity (check all that apply). *

- ☐ Asian
- ☐ Native Hawaiian or Other Pacific Islander
- ☐ Black/African-American
- ☐ White
- ☐ Hispanic/Latino
- ☐ American Indian/Alaska Native
- ☐ Other - Write In
- ☐ Prefer not to answer

14. Generally speaking, do you think of yourself as a Democrat, Republican, Independent or something else?

- ☐ Democrat
- ☐ Republican
- ☐ Independent
- ☐ Something else - Please specify

15. How would you characterize your political stance?

- ☐ Extremely Conservative
- ☐ Conservative
- ☐ Moderate
- ☐ Liberal
- ☐ Extremely Liberal

16. Please leave any additional comments you have here.

Appendix D: Violence Project Interview Summary

During our research, we interviewed James Densley, one of the leading experts on gun violence and mass killings. Dr. Densley has also employed systems thinking in his analysis, and has spent years studying mass killings, what causes them, and strategies to prevent their occurrence. Densley's analysis suggests

that there is no one catch-all solution for addressing mass killings. As there are a variety of factors that all contribute to an individual committing a mass killing, so are there a variety of different solutions that must all be employed in tandem to comprehensively address the problem

Dr. Densley also discussed the role that partisan politics and modern media play in exacerbating the issue. Given the highly contentious nature of many of the proposed solutions to mass killings, there is often opposition to at least some of the proposed solutions from nearly everywhere on the political spectrum. For example, more comprehensive firearm control is certainly a part of the solution, but many groups oppose any increase in gun control and suggest the issue is solely due to mental illness or some other factor. At the same time, other groups think that gun control is the only solution, and feel that other strategies are just piecemeal propositions to distract from the need for gun control. Dr. Densley's research states that both gun control and better mental healthcare are both essential to addressing the issue, but the focus on singular factors due to the emotionally charged beliefs of different groups has created a political climate where it is difficult to promote the idea that multiple solutions are needed together.

Modern media has also contributed to the problem. In their quest to maintain ratings and appeal to their specific viewers, media outlets often end up reinforcing the idea that there is a single solution to the issue (that solution often being different depending on the political leanings of that media outlet). In addition, these outlets often focus on details about killers. While this is also typically done to keep the news "exciting" and bring in viewers, research has shown that this has an overall detrimental effect, as it increases the notoriety of mass killers and can encourage "copycats".

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