Taking Complex Systems Seriously: Visualizing and Modeling the Dynamics of Sustainable Peace

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Abstract

The recent United Nation Secretary General's report on sustaining peace speaks to an urgent crisis of complexity in global affairs, where a wide assortment of nonstate actors wields more political power than ever before. In this context, the international community's traditional ways of forecasting, planning, policymaking, and assessing impact are becoming rapidly obsolete. In response, policymakers are calling for more holistic or systemic approaches to peace and development. Unfortunately, these proposed changes are merely 'systems light', essentially a metaphorical characterization of peace systems where their component parts are seen as interconnected and complicated. This form of systems thinking is insufficiently informed by more sophisticated methods from complexity science. This article will illustrate how two methods derived from complexity science, causal loop diagramming and mathematical modeling, can help us understand the properties and dynamics of intervention in complex peace systems. Causal loop diagrams help us to identify the peace factors and the connections between them. Mathematical modeling helps us determine the quantitative results of the interactions between all the peace factors. Using these methods together can lead to new insights for peacebuilding and for mitigating the unintended consequences of well intended policies.

The geopolitical world is becoming increasingly more complex, volatile, and unpredictable. According to former head of UN Peacekeeping Jean Marie Guehenno, today there are seismic shifts in world order from one of hegemony and bilateralism, through multilateralism, to a new crisis of complexity (Guehenno, 2016). In this highly interconnected new order, nonstate actors such as corporations, billionaires, nongovernmental organizations, terrorists, and computer hackers wield more power in the political realm than ever before. Augmenting the proliferation of complexity is the exponential increase in the flow of information. In 1900, knowledge doubled every century. Today, it doubles about once a year, with IBM predicting that soon it will double every 12 hours (Coles et al., 2006). Adding to this, the increasing role disinformation plays on the geopolitical stage (Crilley, 2018), and there is a sense of the current context wherein the international community's traditional ways of thinking, policymaking, and making assessments are becoming rapidly ineffectual and obsolete.

In response to this increasing complexity and volatility, policymakers are calling for more systemic approaches to peace and development. A new SG Report on Peacebuilding and Sustaining Peace (2018) highlights the need for 'a system-wide approach from the United Nations and for close collaboration with partners…to ensure a coordinated, coherent, integrated and results-oriented response' (United Nations 2018, p. 3). Similarly, the 2017 Positive Peace report portends, '. . . new and unique approaches for applying systems thinking to the nation-state to better understand how societies work, how to manage the challenges they face, and how to improve overall wellbeing' (Institute for Economics and Peace 2017, p. 35). Likewise, Jeffrey Sachs characterized the conceptualization and implementation of the 17 Sustainable Development Goals as incorporating 'interdisciplinary complex systems dynamics' (Sachs, 2015). This shift from understanding the pieces of peace to the whole system is promising.

Unfortunately, these proposed changes are merely variations of 'systems light': metaphorical characterizations of peace and development systems where their component parts are seen as connected and complicated. This form of systems thinking is not wrong, but it is insufficiently

informed by more sophisticated methods and findings from complexity science, and therefore only a marginal improvement on standard forms of analysis, policymaking, practice and measurement.

Deeper systems-based approaches such as agent-based modeling (Clarke, 2018), scenario analysis (Lehr et al., 2017), network analysis (Bankes, 2002; Moffat, 2003), and problem structuring (Feder, 2002; Ritchey, 2006) have been developed and utilized by policy makers and the military to understand complex operating environments including humanitarian emergencies and disaster response, environmental planning, human intelligence and counterterrorism, and military campaign planning. In other words, these tools and approaches are increasingly common in policy spaces that deal with conflict (Defense Advanced Research Projects Agency, 2018; Quade and Boucher, 1968). However, policy makers have yet to employ such complexity-based tools to build, make, and sustain peace (Fisher and Rucki, 2017; Krampe, 2017).

In response to this gap, a multidisciplinary team of researchers housed at the Earth Institute at Columbia University set out to employ models and methods from complexity science (applied mathematics) to study the dynamics of sustainably peaceful societies (Advanced Consortium on Cooperation, Conflict, and Complexity, 2018). The remainder of this article will illustrate how two methods derived from complexity science, causal loop diagramming and mathematical modeling, can help us to better understand and track the properties and dynamics of intervention in complex peace systems. We first introduce the causal loop diagram methodology, and discuss two policy interventions employed in Colombia and in the Basque Country. We then introduce mathematical modeling as it pertains to sustainable peace, and describe our ongoing model development. Subsequently, we discuss the practical challenges to integrating complexity-based tools and methods into policy making for peace. The article ends by suggesting ways forward for overcoming those challenges.

Current approaches to comprehending and promoting peace

Today, the international community's efforts to build, make, and sustain peace are largely focused on the important task of identifying the factors that contribute to peace: the primary conditions and policies for promoting peace, and the target goals and indices for measuring and evaluating sustainably peaceful nations. For example, the anthropological study of peaceful societies suggests that a few basic factors are associated with the social networks of peaceful intergroup relations (Fry, 2006, 2007, 2013). These include an overarching social identity that unites groups across their differences by 'expanding the Us to include the Them'; interconnections among subgroups whether they be through trade, intermarriage, or shared ceremonies among social units such as lineages, sports teams, schools, workplaces, and social clubs that bring together members of different groups to peacefully live, work, learn, and play together; cooperative forms of interdependence or shared goals,

resources, or fates due to mutual ecological or economic dependencies or common security interests; socialization of non warring values and taboos against violence in homes, schools and communities; symbols and ceremonies that celebrate and reinforce peacefulness; functional superordinate institutions that promote intergroup integration; fair and constructive conflict management mechanisms that help manage disputes between members of different groups when they arise; and visionary leadership that offers a sense of the positive potential for peace and how to achieve it. Research by political scientist Valerie Hudson et al. (2012) adds the physical security of women, demonstrating that the level of violence against women in society is a better predictor of state peacefulness, both internally and internationally, than levels of democracy, wealth, or prevalence of Islamic religion.

However, because all local national and international situations involve a large set of peace and conflict-related factors that are interconnected in complex ways, it is extremely hard to predict changes in any of those factors or in levels of peacefulness when an intervention is introduced or when an exogenous shock occurs. The inability to do so has often resulted in 'unanticipated consequences' that are counter to the goals of the intervention (De Coning, 2016; Dorner, 1996). Findings indicate that the manner in which different peace factors interact with one another over time to affect cultures of peace is as important to understanding peace sustainability as any of the factors themselves. To predict the responses to a new policy intervention requires a sufficient understanding of the broader system and how the whole system will respond to a given intervention over time. In other words, policy makers need tools to understand and assess how a given change will affect the target system components as well as how the changes will cascade across all of the interconnected system components. This lesson is vital to understanding the sustainability part of sustaining peace. To demonstrate how such tools can be utilized in policy making processes, we briefly introduce two illustrative tools that we have employed to assist policy makers develop strategies to further peace.

Tool 1: mapping multiple causality of complex peace systems

Findings show that a heuristic tool called causal loop diagramming (CLD) offers a facile, agile, and surprisingly powerful approach to operationalizing systems thinking in peacebuilding by enabling collaborative visioning and planning exercises. CLD is often used in building descriptive representations of a system that can serve as a foundation for further diagnostic, analytic, and prescriptive modeling. This can be done via an analyst or expert driven process, as is typically done in an interagency policy setting (Geller et al., 2011; Latek et al., 2012), or by bringing stakeholders together from different segments of society (civil society, academia, business, track one and two, government, and so on) to physically draw how different conditions and factors in communities affect one another in complex ways to

affect the dynamics of peace (Ricigliano, 2003). The latter approach is often used by civil society and grassroots organizations attempting to inform and influence policy processes (Burns, 2014). Such processes can foster more nuanced forms of systemic thinking, engender meaningful dialogues between stakeholders, and offer new insights and opportunities for sustaining peace. When employed with sector experts and policymakers, these visualization methods can also help to generate new questions and hypotheses for data gathering, organize available knowledge in more integrative ways, and act as a diagnostic tool to help identify potential gaps in current policy approaches (Vandenbroeck et al., 2007).

For example, in the context of the recent peace process in Colombia, we partnered with the Fragility, Conflict and Violence Unit of The World Bank to aid in the exploration of the role of memory and reconciliation in sustaining peace (Fisher et al., 2015). Our team facilitated a 3-day workshop in Bogota with members of nine governmental and civil society organizations there working on these issues, to explore the dynamics across local, regional, and national levels that affect their ability to support local communities and to identify opportunities to leverage their collective impact. The workshop utilized causal loop diagramming to help the participants visualize their understanding of the larger system dynamics affecting their work, and to situate the impact of their individual projects in this broader context.

Similarly, in 2016, our team conducted several complexity mapping sessions in the Basque Country, which included stakeholders from the public, private, academic, and civil society sectors (Donahue et al., 2017). For the workshops, stakeholders were asked to share a story that represents sustainable peace in their community. Stakeholders shared their stories, and the project team and workshop participants listened actively to identify and record the processes, factors, and conditions identified by each storyteller. These elements were recorded on Post-it® notes, which were collected at the workshop's conclusion. Following the workshops, the project team analyzed the factors identified by the stakeholders, and from these, created localized maps of sustainable peace. In follow up sessions, the team described their process for creating the draft localized map, and then stakeholders were provided the variables again and were invited to manipulate the placement of these variables and the connections between them, thus constructing their own version of a CLD. The stakeholders then presented their maps, and the meaning and implications of the maps were discussed (See Figure 1).

Facilitating processes for envisioning the complex factors and dynamics inherent to sustaining peace can support members of local communities and the international community in better articulating such visions. Research has found that thinking and acting in more integratively complex ways, particularly when addressing complex challenges, leads to better decisions and outcomes (Tetlock, 2005). This involves a process of both divergence, where different aspects of the challenges are considered from multiple perspectives, and convergence, where these views are synthesized sufficiently to make decisions. Such processes can result in what Vaclav Havel described as illuminated truths, when he wrote, 'Simple answers which lie on this side of life's complexities are cheap. However simple truths which exist beyond this complexity, and are illuminated by it, are worthy of a lifetime's commitment'.

The generation of CLDs with community stakeholders or external experts can help to identify some of the more important factors and how they interact with each other. In this way, they can provide an overall picture of the whole system. However, CLDs are limited in that they make it hard to trace through the effects of a change in one factor to the many other factors that it influences, and then even further from those influenced factors to the additional peace that they influence. In addition, the factors included in most CLDs usually do not have quantitative values assigned to them so their relative importance in the whole system is often hard to determine. Thus, the real value of this approach to policy making around peace is threefold: heuristic, exploratory, and descriptive.

For policy making to be more effective at sustaining peace, the threefold value of the CLD approach needs to be augmented with the diagnostic, analytic, and prescriptive value that additional modeling can provide. This entails combining the human, social, and participatory expertise of social scientists and peacebuilding practitioners with the technical and methodological expertise of physicists, data scientists, and other applied mathematicians to help move beyond a metaphorical understanding of complexity, and begin to integrate the insights, models and methods from the study of complex networks, emergence processes, attractors dynamics, and other areas of nonlinear dynamics into policymaking and assessment. This is increasingly common in conflict prevention but is still nascent in the pursuit of peace (Blattman, 2018; Blattman et al., 2017; Jha and Shayo, 2016).

Tool 2: mathematical modeling of the causal loop diagrams

Given the increasing complexity and volatility of modern societies, understanding exactly how a given policy will affect the vast number of factors that interact across time to sustain peace feels impossible. However, mathematics is very good at doing just that. If we can identify the primary factors that drive or jeopardize peace in a community, and have a decent estimate of the degree of influence of each one on the others, we can compute the effects of an intervention on the entire system. This process is critical because systems can have different properties. In some systems, there is a single leverage point and an intervention at that point changes the entire system. A thunderstorm in Atlanta disrupts airline traffic across the entire United States because so many flights pass through the Atlanta hub. On the other hand, our developing mathematical model of sustainably peaceful communities suggests that there is no single leverage point, no magic single action that leads to peace. Rather, sustainable peace seems to depend on the

Figure 1. Stakeholder causal loop diagram in the Basque Country.
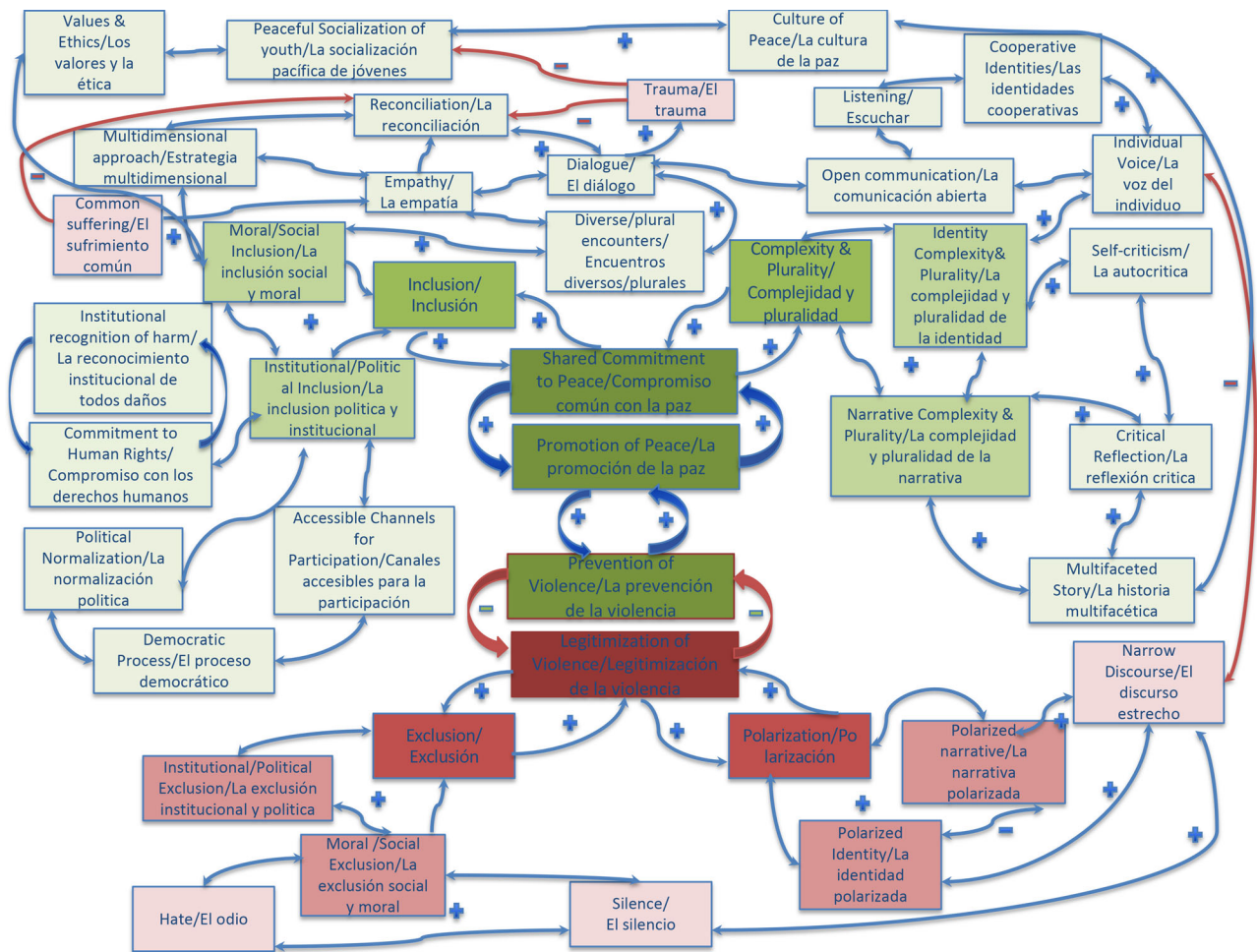
collective actions of a large number of independent peace factors.

For example, our team studying sustainably peaceful societies at Columbia includes Dr. Larry Liebovitch, an astrophysicist who has been translating our conceptual models of peaceful societies into mathematical equations, which allows us to investigate them through the use of computer simulations. In a recent run of the simulation, we channeled the effects of the many positive peace variables in our model through one 'gatekeeper' variable. This, in essence, could represent the effects of increased coherence and coordination being called for in the SG's report. It was discovered, surprisingly, that channeling forms of coordination in the model through a single 'gatekeeper' variable actually diminished the positive affects that the variables previously evidenced on the dynamics of societal peace. Of course, this finding has no direct bearing on the actual implications of any specific policy recommendation. It does, however, illustrate how employing the use of mathematical models and computer simulations can provide the tools with which such proposed changes might be better understood and refined.

Fortunately, the physical science expertise on the SPP team provides an additional approach that yields new information on the system properties of the CLD. In physical science, mathematical models can be used to determine how microscale individual interactions between parts of a system produce the macroscale system properties of the entire system. A rigorous mathematical model was constructed from the CLD (Liebovitch et al., 2018), where each peace factor has a quantitative value determined by its own properties and by its interactions with all the other peace factors. Thus, the interactions of all the peace factors can be computed together at once.

By running the mathematical model of sustainable peace, it was found that, over long periods of time, this system reaches only two stable configurations called 'attractors': either the positive peace factors (such as Positive Intergroup Reciprocity or Positive Intergroup Goals and Expectations) have high values and the negative peace factors (such as Negative Intergroup Reciprocity or Negative Intergroup Goals Expectations) are zero, or vice versa. A series of runs of the mathematical model illustrated that the stronger and

longer lasting effects of the negative peace factors can be restrained either by including the influence of many additional positive peace factors in the system, or by strengthening 'gateway' positive peace factors that play crucial roles in how interactions spread through the whole system. Since there are different ways to achieve a successful peace system, this also implies that the best choice of an intervention may be situationally dependent.

The mathematical model is only useful to social scientists, practitioners, and policy makers if they understand its behavior and are able to vary the parameters of the model to explore consequences of those interventions. The computer science expertise on the SPP team provided the capability to create a graphical user interface (GUI) for the mathematical model derived from the CLD. This computer program (coded in Python 3 using Tkinter) is available, as open source, on GitHub (Liebovitch et al., 2018). The program presents the names of the peace factors on the screen with sizes proportional to their values. The value of mathematical models to policymakers is greatly enhanced by employing a graphical user interface, so that interventions can be put into the system through point and click actions. Policymakers can then use the interface to explore the system-wide effects and the time course resulting from different interventions. In this way, different hypothetical scenarios can be tried, evaluated, and judged against one another (See Figure 2).

The interactions between the peace factors are presented as directed colored arrows, blue for enhancing the target peace factor and red for diminishing the target factor; and the width of the arrows is proportional to the strength of the interaction between the peace factors. The actions in the program are controlled by mouse actions of pointing and clicking on entry boxes or the peace factors themselves.

Figure 2. Graphical user interface for the mathematical model.
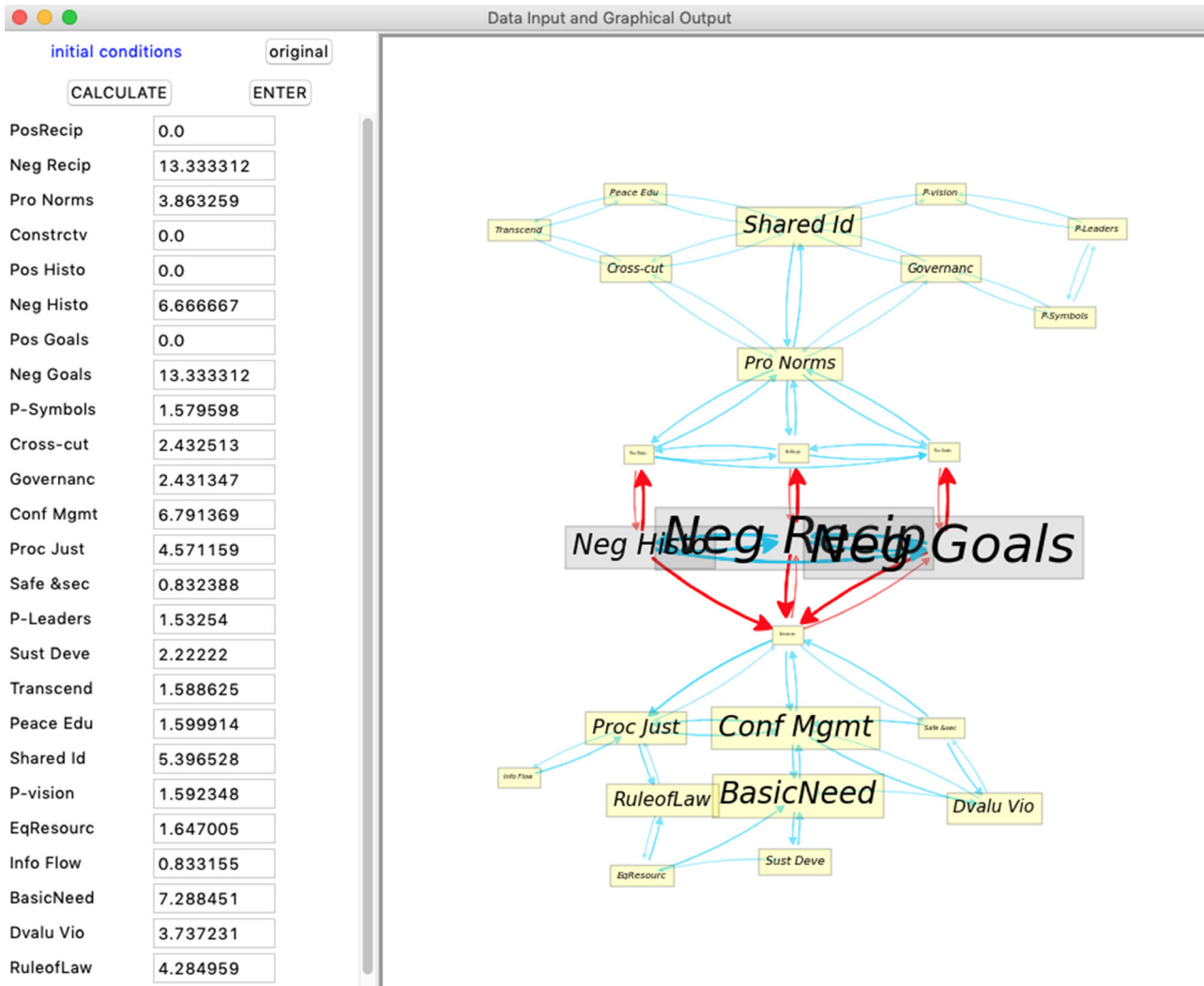
When the 'calculate' box is clicked, the program uses the mathematical model to numerically integrate the equations in time. The results are presented as a graph of the value of each peace factor as a function of time and an updated display of the peace factors with sizes proportional to their values. There is nothing better than a picture to show what is happening, and with the point and click controls the user can change parameters of the mathematical model, see what happens, and continue to explore the consequences of different interventions in the system.

The SPP team subsequently formulated operational definitions of the peace factors and use data science methods to analyze structured and unstructured (social media) data to provide quantitative values of Positive/Negative Intergroup Reciprocity, Positive/Negative Intergroup History, and Positive/Negative Intergroup Goals and Expectations, towards developing enough quantitative empirical data to test, improve, and validate the model. The future development of a validated, user-friendly model will provide both scholars and practitioners a helpful tool in understanding a sustainably peaceful system and in designing successful interventions.

The challenges of complexity informed policy making for peace

Across these illustrative examples, the potential that these tools have for informing policy making to enhance and sustain peace is clear. At the same time, limits exist in the form of some very real barriers to entry for policy makers to adopt and implement these and other approaches. The transition from standard forms of policymaking and practice on peace-related initiatives to those incorporating complex systems thinking, analysis and action are challenging (De Coning, 2016). For instance, the policy making architecture is replete with militaries and departments and ministries that focus explicitly on defense, or departments of state and regional intergovernmental bodies that focus on diplomacy and trade. However, there are few such organs that are dedicated to peace policy. Some examples do exist, such as the United States Institute of Peace, Ethiopia's new Ministry of Peace (Shaban, 2018), Nepal's Ministry of Peace and Reconstruction (Government of Nepal, 2018; Thapa, 2007), and the United Nation Department of Peacekeeping Operations. However, such organs typically suffer from a position on the fringe of policy making, lack of a clear mandate, or a mission that is focused on conflict prevention rather than promoting and sustaining peace. Thus, the end user of complexity-based peace tools is unclear. The adoption of such tools by the conflict prevention policy making community was facilitated by clear end users, with identified mission or policy goals that cannot be solved by conventional approaches, and the resources (funding, staffing, time and commitment) to learn how to develop, implement, and utilize the lessons from such tools. Without such a community and such resources, it will remain difficult to realize the potential of complexity-based approaches in pursuing peace.

A related challenge for implementing new tools and approaches in peace policy making relates to the diverse factors that are associated with peace, which are categorically different from those associated with violence and conflict. This research has demonstrated that sustainable peace is a product of intergroup memory of peaceful interaction, intergroup reciprocity that supports and reifies positive interactions, and intergroup expectations of future peaceful interactions. Furthermore, this research has highlighted that the drivers of each of those primary factors are diffuse, ranging from basic needs and wellbeing, to procedural, distributive, and environmental justice, and extending to inequality, economic interdependence, and social norms and structures. With such a diverse set of drivers, policy making across agencies, ministries, and international bodies needs to be coordinated and harmonized to avoid the well-intentioned work toward, for example, food security of one policy making body undermining the work toward distributive justice of another.

A further challenge for policy makers that are interested in adopting complexity-based methods for policy making lies in the uncertainty and the complexity associated with these new tools and approaches. Whether due to a fast evolving policy problem, restrictions on resources and time available to devote to policy making, or pressure from an actively engaged constituency, policy makers need to be able to act with certainty, decisiveness, and confidence that their actions will lead to predictable outcomes. Unfortunately, the conventional analytical approaches that are employed often provide only the illusion of certainty, masked by a lag between the implementation of a policy and the impact of the intended and unintended consequences that it gives rise to. In contrast, a complexity informed analytical approach eschews the faux certainty of conventional methods and embraces uncertainty as a core, inevitable component of social and political systems. In so doing, it gives insight into the potential and probable effects of an action and illuminates the multiple types of uncertainty that underlie a policy decision. This alone adds tremendous value to the ultimate outcome of a decision, by enabling policy makers to be more thoroughly informed. However, it does not provide the neat and clean direction that policy makers often seek and must explain to other stakeholders.

The lessons from complexity science demonstrate that policy makers need a more coordinated approach to peace policy. However, that does not mean that waiting is necessary for such coordination to begin to implement new tools and approaches. Rather, the uptake of such tools by a few early pioneers could demonstrate the tangible value additive impacts of complexity informed peace policy, and thereby lower the barriers to entry and uptake for additional users. For example, the same ministry that works toward food security in international development policy making could utilize the heuristic potential of CLD's to explore the impact of a food security program across an entire regional or country portfolio. From there, they could build scenarios accounting for different technologies, intensities, and service

delivery mechanisms to assess what unintended consequences (beneficial or detrimental) might arise from various interventions, and build contingency plans to either prevent damage, or multiply the benefits of programming across interconnected policy spaces.

Our early experiments in coordinated policy making have shown that complexity informed coordination requires, and is enhanced by, a shared and nuanced understanding of each actor in a complex system as well as their activities, incentives, motivations, and capacities. For instance, we previously introduced a complexity-based approach we implemented to assist a group of NGOs and policy makers in understanding the relevant actors and portfolios of work around violence prevention and memory and victimization in the recent Colombian peace process (Fisher et al., 2015). Through a series of systematic, participatory actor assessments and network mapping exercises, stakeholders were able to identify redundancies, gaps, and synergies in service provision. This served to strengthen some networks of service providers and create new linkages, and also served to enable interagency discussions on strategies to increase efficiency in resource deployment and coverage. Building on that experience, this work with policy makers and civil society in the Basque Country (Donahue et al., 2017) highlighted the importance of eliciting the nuanced understandings that shape each actor's internal narrative of the issues underpinning their work in peace promotion, violence prevention, and social development policy making. Idiosyncratic experiences, assumptions, expectations, and motivations lead groups and agencies to define the policy problem uniquely and underpin their individual policy responses. This lack of a common problem definition can lead to policies that unintentionally undermine one another, or cause shocks in other proximate policy spaces that may affect other actors in the system.

Fortunately, policy makers are increasingly aware of these dynamics, and toolkits are increasingly available to assist them better understand the system, develop common definitions of the policy problem space, and anticipate shocks (Ritchey, 2006; USAID 2017). While this sort of policy work already takes place in at least some spaces, it is still usually relegated to conflict and violence prevention. What we propose, however, requires a normative shift to coordinate across policy making bodies to intentionally build peace, or at least utilize existing policy making to enhance peace as a dividend of other policy goals.

Moving the peace policy agenda forward with complexity-based tools

While the paradigm shift we discussed above is no doubt aspirational, experience from our illustrative examples as well as from other sectors that have successfully made this shift demonstrate that incorporating new ideas and methods from complexity science more centrally into peace policy making not only can increase the efficacy and sustainability of policies and practices, but it also can help

to reduce the unintended consequences of well-intentioned actions that often plague international intervention regimes. The question, then, is how to practically move forward the complexity-based approach to policy making and begin to overcome the challenges discussed above.

Our first response to that question addresses the challenge of end users. The increased calls for complexity aware approaches coming from the international community, as well as domestic policy makers, show that there are in fact end users of complexity-based tools who are immediately willing to explore the utility of these tools. Furthermore, the small but ever growing number of ministries, agencies, and departments in governments that fall under the umbrella of peace shows that there are indeed would be end users, if only they knew and had capacity to adopt new technologies. These would be adopters should be engaged directly by the analytical and academic community in order to enhance policy makers' knowledge and fluency with existing complexity-based support tools. Furthermore, partnerships between policy makers, analysts, and academics need to be fostered that focus explicitly on research and development in the context of peace. Similar partnerships are commonplace in the sectors technology, military, international development, and finance, and have led to important innovations that have benefited society. Peace would be the greatest value add possible from such partnerships.

Our second response to the question of how to move the agenda forward addresses the issue of diffuse and diverse drivers of peace. Because peace is necessarily an intergroup, interactional phenomenon that is driven by a multiplicity of social processes, there cannot be a sole centralized authority responsible for policy making around peace. Rather, the coordination of multiple policy making bodies who affect the drivers of peace is essential. Furthermore, those bodies whose actions either directly or indirectly influence the levels and sustainability of peace need to understand the impact of their policies on the larger peace system. Both of those needs can be addressed via a complexity-based framework, but first there needs to be more foundational research done to illuminate the mechanisms by which the drivers of peace actually affect the core factors that contribute to peace. This requires bolstering an analytical community of practice to share knowledge, tools, and build the evidence base describing causal pathways and network structures. This also requires deeper engagement with the policy making communities who have already adopted complexity-based approaches to learn how to successfully integrate these approaches into policy making.

Our third response builds on this to address policy makers' need for reliable, facile, and dependable policy guidance. By now the international community understands a great deal about violence and conflict prevention. We know many of the causal pathways, we understand how to measure conflict and its drivers with increasing precision, and we understand how to quickly and (sometimes successfully) implement preventative measures based on early warning analytics. The same is fundamentally untrue for peace. Despite decades of research, there is still only a cursory

understanding of peace as a phenomenon distinct from conflict. A great deal of analytical energy is being devoted to that study by diverse researchers and partnerships including the International Institute for Economics and Peace, the Peace Research Institute of Oslo, and many others. Indices and metrics of peace are increasingly robust including the Global Peace Index and the Positive Peace Index. Each new advance is a step closer to understanding, measuring, and ultimately developing policy guidance to prescribe peace. However, research is still far short of that goal. Better metrics must be developed that precisely capture the intergroup and interactional dynamics of the phenomenon, as well as the underlying drivers and network structures that create peaceful social dynamics.

Policy implications

1. **Incorporate ideas and methods from complexity science into peace policy making** to increase policy efficacy and sustainability and reduce unintended consequences of well-intentioned practices of international intervention programs.
2. **Actively foster partnerships between policy makers, analysts, and academics** that focus explicitly on research and development in the context of peace.
3. **Sponsor and support foundational research** to illuminate the mechanisms by which the drivers of peace actually affect the core factors that contribute to peace.
4. **Bolster an analytical community of practice to share knowledge, tools, and build the evidence base** describing causal pathways and network structures. This also requires deeper engagement with the policy making communities who have already adopted complexity-based approaches to learn how to successfully integrate these approaches into policy making.
5. **Develop better metrics** that precisely capture the intergroup and interactional dynamics of the phenomenon, as well as the underlying drivers and network structures that create peaceful social dynamics.

Conclusion

The 'systems lite' approach to peacebuilding, peacemaking, and sustaining peace is a welcome addition to the conventional approaches to policy making that have traditionally been employed. Such metaphorical and descriptive approaches have opened the door to complexity informed policy and have increased the popular and political willingness to engage with uncertainty. However, the progression must be continued toward developing and employing methodological approaches to policy making and policy support that capture the heuristic, exploratory, descriptive, diagnostic, analytical, and prescriptive potential of complex systems tools. The international community is urged to continue on this trajectory by incentivizing and supporting the systematic study of peaceful societies and the development of measurement indices that assess complex dynamics directly related to promoting and sustaining peace.

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