ACTIONABLE KNOWLEDGE MAPPING TO ACCELERATE INTERDISCIPLINARY COLLABORATIONS FOR RESEARCH AND PRACTICE

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ABSTRACT

With increasing calls for interdisciplinary collaboration to solve wicked complex problems there is also increasing clarity around barriers to collaboration such as differences in research methodologies and disciplinary terminologies. This paper uses a Science of Conceptual Systems (SOCS) perspective to show how theories from different disciplines may be synthesized (or integrated, depending on your preferred terminology). Brief case studies are presented to show how knowledge mapping may be used to accelerate actionable scientific understanding, interdisciplinary collaboration, student learning, and practical application leading to increasingly successful and sustainable change for improving the human condition.

Keywords: Interdisciplinarity, Integrative Propositional Analysis, Metatheory, Collaboration, Systems philosophy

INTRODUCTION

Despite the obvious need for interdisciplinary collaboration to better understand and resolve wicked complex problems, effective collaboration across disciplinary lines remains a relative rarity. While the many barriers to interdisciplinary collaboration (e.g. differences in nomenclature, and research methods) may represent a paradigmatic chasm, there exists at least one way to bridge such a gap using an approach that emerged from systems philosophy by synthesizing (or integrating) theoretical models. For most of the academic world, however, synthesis has proved problematic.

Perhaps the most common complaint regarding interdisciplinary programs, by supporters and detractors alike, is the lack of synthesis—that is, students are provided with multiple disciplinary perspectives, but are not given effective guidance in resolving the conflicts and achieving a coherent view of the subject. https://en.wikipedia.org/wiki/Interdisciplinarity (accessed 4 June 2918).

Key to that complaint is that synthesis "has always been something of a mystery" (Newell, 2001, p. 18) for many students and researchers. That means we have a weak link in our system of education, research, and practice.

Instead of rigorous and effective interdisciplinary synthesis leading to useful theories for practical application and successful results, we are faced with fragmentation within most or all disciplines including sociology (Bakker, 2011), philosophy (Ledoux, 2012), interdisciplinary studies and systems theory (Newell, 2007). Rather than achieving successful and sustainable results for our policies and programs to address the wicked complex problems of the world, we frequently have "worse outcomes than the previous status quo" (Beaulieu-B & Dufort, 2017, p. 1).

To counter fragmentation this paper presents a science of conceptual systems (SOCS) approach to synthesis. A conceptual system is any kind of theory, model, knowledge map, or similar structures of interrelated concepts. The SOCS perspective accepts that conceptual systems from all disciplines have important similarities.

Core to systems philosophy is the idea that systems are made of elements and relationships (von Bertalanffy, 1972). Reflecting real world systems, conceptual systems include elements and relationships. The elements are concepts (or variables) and the relationships are the causal connections between concepts. In a diagram or knowledge map (or, more simply, a map) elements and relationships are often represented as circles connected by arrows indicating the direction of causal effect (Figure 1).

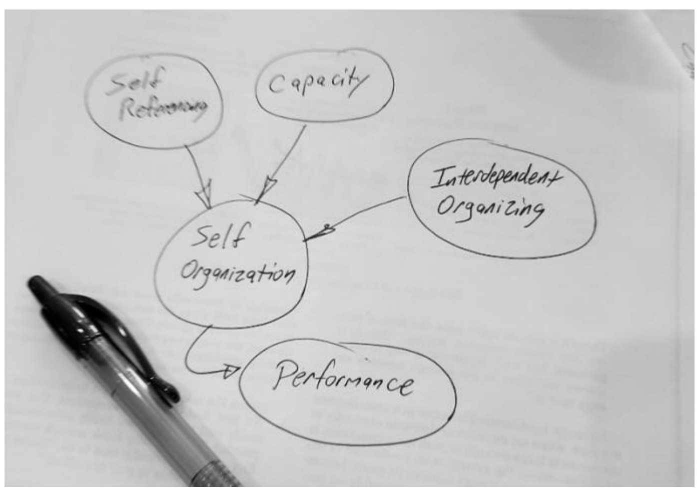

Figure #1 – Example of a knowledge map with circles for concepts and arrows showing direction of causality

A theory, much as a human or ecological system, advances or improves as it becomes more systemic (or coherent). This occurs as the system gains a greater variety elements, and as those elements are more connected. Importantly, it seems that we live in a world of systems. Therefore, we need theoretical models which are more systemic to understand and solve problems within that systemic world.

SOCS methods enable the rigorous synthesis of theoretical models along with methods for evaluating the systemic structure of theories. Thus, we are able to show improvement with some level of objectivity.

Generally, this paper addresses four interrelated issues to support rapid advances in the systems sciences, as well as in interdisciplinary efforts across multiple sciences for the betterment of the human condition.

First, by focusing on the elements and connections, it becomes easier to integrate/synthesize theories within and between disciplines (Figure 2).

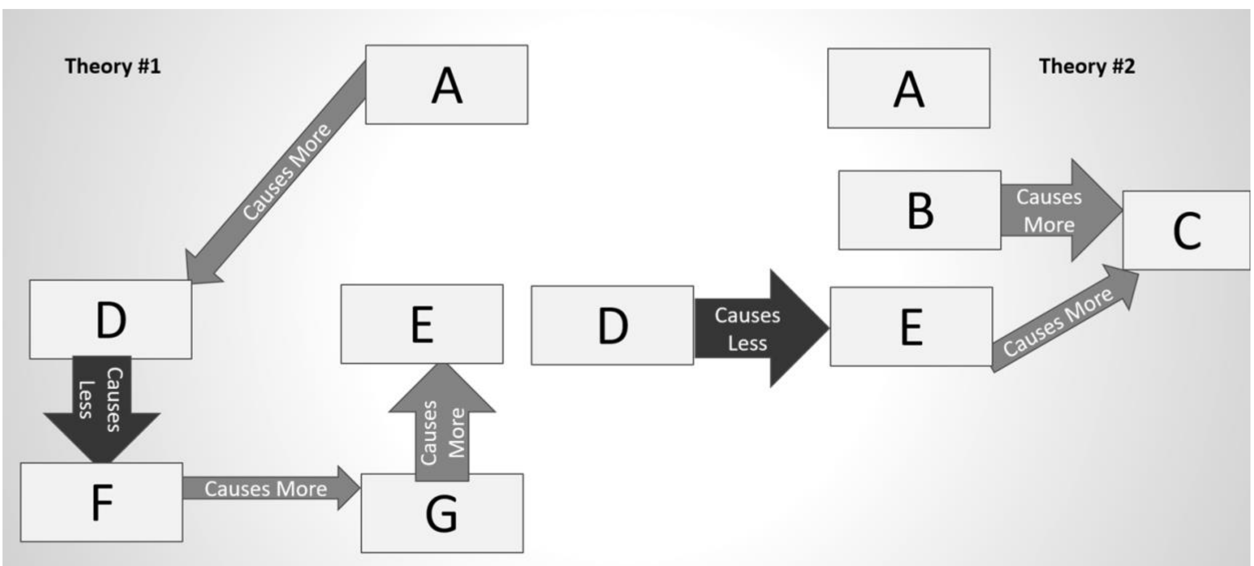

Figure 2 – An abstract example of two theories

Consider Figure 2 showing two theories. Here, the concepts within the boxes are abstractly represented by letters. Note that both theories contain the concepts A, D, and E. Therefore, the theories may be effectively synthesized at those "overlapping" concepts to form a new theory (Figure 3).

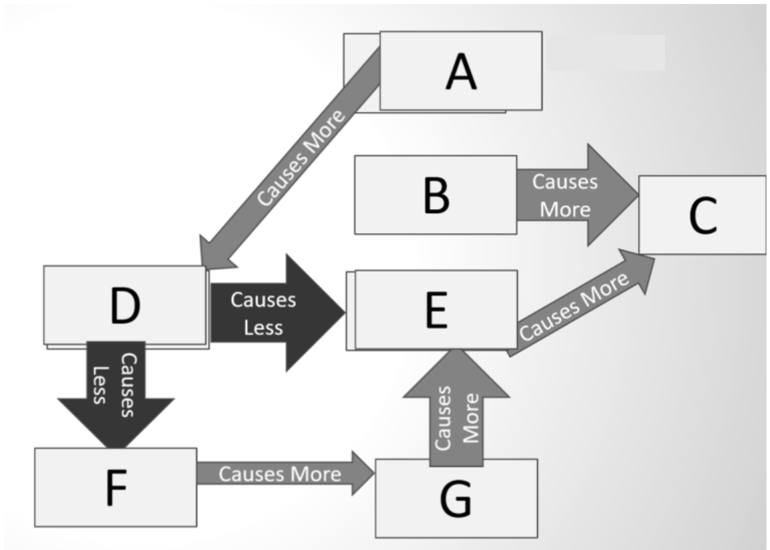

Figure 3 – Resulting synthesized theory

That synthesis, in turn, serves to reduce fragmentation and improves the potential usefulness of theories. Second, by focusing on measurable concepts and causal relationships (more specific forms of elements and connections) theories are generally more actionable because they present a map of interrelated options for actions and their anticipated outcomes. Third, knowledge maps (as graphic representations of theories/models) are useful for guiding collaboration between researchers and/or practitioners because the map indicates where synergies among various activities to support greater sustainable success among collaborators. Fourth, understanding the structure of a map means that we can purposefully improve that structure more easily, thus accelerating improvements in theory and practice.

With this new perspective, participants will be empowered to be more effective teachers, consultants, and agents of change. Processes and paths for encouraging collaboration will be presented for use in academic research, classrooms, action planning, and consulting projects along with examples from theory and practice.

Because some systems thinkers are (rightly) concerned about assumptions based on “simple causality” or “partial causality,” it is worth briefly mentioning here, the importance of causality. Understanding causal relationships supports long-term learning in children (Bauer, Booth, & McGroarty-Torres, 2016) as well as improving understanding for adults (Johnson-Laird, 1980, p.

107). More specifically, maps based on causal relationships have been used effectively in business settings (Axelrod, 1976). Quite simply, it is the best path to scientific understanding (Pearl, 2000). And, importantly, SOCS is not interested in supporting assumptions of simple causality; rather, an important goal is to develop theories representing complex and interconnected causal networks.

The remainder of the paper begins with a brief review of that research stream. Then, I present case studies to illustrate the benefits of a SOCS approach to supporting interdisciplinary advancement of theory as well as a classroom learning tool and a foundation for professional collaborations in the field. Finally, the paper concludes with some limitations and opportunities for advancing SOCS along with advancing other sciences.

THE SOCS STREAM

For a more detailed report on this stream, please see (Wallis, 2016).

Starting around the middle of the 20th century, the idea became increasingly acceptable that humans and communities have mental models (Kelly, 1955) consisting of interconnected concepts which represent our understanding of the world and how it works.

A research stream on Integrative Complexity found that organizations, teams, and individuals with more complex models were more successful in their efforts to reach their goals (cf. Suedfeld, Tetlock, & Streufert, 1992; Wong, Ormiston, & Tetlock, 2011).

In general, however, our human minds don't seem to hold models that are highly systemic. Models are often fragmented (Lane, 1992) and efforts by scholars to synthesize them are often unsuccessful; resulting, instead, in more fragmentation (Wallis, 2014b).

Focusing more on academic theories, SOCS research supports the idea that knowledge which is more systemic (having more elements and relationships) will be more useful for making effective decisions and reaching goals (Houston, Wright, & Wallis, 2017; Wallis, 2011, 2013, 2015a, b; Wallis & Valentinov, 2016a; Wallis & Wright, 2015b). More generally, and more recently, the SOCS stream includes dozens of publications (by individual scholars and collaborative efforts) in peer reviewed journals across multiple disciplines, hundreds of citations, a Fulbright Specialist project, an award winning paper, consulting project to support strategic planning in businesses and non-profits across the US and in other countries, in classrooms to support learning, and (most recently) a contract with Sage Publishing for a research textbook focused on actionable knowledge mapping.

Because those elements and relationships exist in a kind of systemic structure, SOCS enables the relatively straight-forward synthesis of theories from multiple disciplines in a way that supports actionable understanding and collaboration – a breakthrough for the field of interdisciplinary studies where effective synthesis has been described as "elusive" even "mysterious" (as noted in the Introduction, above) with many researchers relying on intuition instead of science.

With SOCS, the process of synthesis becomes more of an asset than a source of confusion for scholars and practitioners because we can show, with some level of objectivity, the extent to which that synthesis improves the usefulness of actionable knowledge for reaching stated goals. That synthesis helps to resolve Apostel's concerns around disciplinary fragmentation (Apostel, Vanlandschoot, Bailis, & Klein, 1994); including the difficulty of integrating people and ideas to solve real-world problems. SOCS also helps to resolve Rousseau's issues with the problem of relativism (Rousseau, Wilby, Billingham, & Blachfellner, 2016) by providing a new method for measuring the validity of disparate views – and to synthesize them into something that is more useful.

Using SOCS for interdisciplinary synthesis is "gaining steam." Recent papers include (Wallis, 2014b), where theories from "natural systems" and "service systems" are synthesized. Also, theories from sociology, political sciences, and complexity sciences are synthesized in a study on entrepreneurship (Panetti, Parmentola, Wallis, & Ferretti, 2018). Additionally, theories of power as applied in disciplines of business, sociology, and political science were synthesized (Wallis & Johnson, 2018).

The experience of writing that last-mentioned paper highlighted for me a problem that supports fragmentation while limiting the advance of science.

It might go without saying, to any published expert, that the full measure of expertise never makes it to the printed page. However, if we have no way of measuring that knowledge, reviewers and editors may (seemingly) reasonably suggest that an article be reduced in "size" without regard to the reduction of knowledge. It was with that in mind that the first of the following case studies emerged.

CASE STUDIES

Here, I present very brief case studies to provide examples and potential directions for interdisciplinary synthesis.

Asking the Expert

Using IPA to map, evaluate, and integrate multiple theoretical perspectives from journal articles has proved illuminating; and, importantly seems to point us in an effective direction for creating more useful theories and accelerating the advance of science. There is at least one critical underlying perspective that has not been taken into account.

While writing (Wallis & Johnson, 2018), and synthesizing theories from different disciplines the question arose as to whether the article adequately capture the author's understanding of the theory. That is an important question for at least two reasons. First, it may provide an interesting approach to improving the knowledge mapping process. Second, the question underpins an important foundation of the academic world. That is, if the representation provided by articles may be improved, we should consider revising our academic system for learning and sharing knowledge.

For this case, I used a description of power (as used in organizations) found in a recent publication (Fink, 2017). I created a map based on the text and asked the author to review it.

Drawing on his interdisciplinary expertise, and using the clarity of the causal mapping process, Fink identified causal links which were not included in the original (text-based) publication. Adding those links increased the connections between concepts on the map. While the original map had a structure of only 0.16, the revised map had a much improved systemic structure of 0.47. There are important lessons to be learned by this. Recall that, based on SOCS, that improvement indicates that the revised theory is more likely to be useful in practical application for reaching desired goals as well as for teaching and advancing research.

First, authors relying on text alone are prone to represent only a small piece of their understanding. Second, if we are to understand each-others' thinking, articles should include causal maps, and links to online maps – where more complete understandings may be presented and dynamic conversations may take place. Third, practitioners (including policy experts) who are reading published research should be aware that a research article probably does not tell the whole story.

This exercise, leading to measurable improvement in the structure of the theory, suggests new insights into accelerating the advancement of theory within a discipline and hints at the ability to improve theories between disciplines (should the process be repeated with experts from multiple disciplines). First, the limited Systemicity (and related limited usefulness) might provide a hint as to why people so often misunderstand one another – fragmented mental models are not good for communicating complex ideas. Second, the benefits of causal mapping and the clarity of IPA suggest that more scholars should use those methods for analyzing existing theory and developing their own theories. Third, if a causal map and IPA analysis were to accompany each journal submission, the job of the editors and reviewers would be easier – again supporting the acceleration of science (Wallis, 2015b).

Fourth, it seems highly relevant that this mapping process is very useful for surfacing, sharing, and understanding the knowledge among experts because structured knowledge supports learning (Curseu, Schalk, & Schruijer, 2010; Goltz, 2017; Russell & Wallis, 2015). Thus, mapping helps researchers, teachers, practitioners, and students – thus supporting a wide range of interconnected processes. On the negative side, those scholars who are visually impaired or have weak visual learning abilities may not find a mapping-focused approach highly useful.

While it may come as no surprise to some that the map is improved by adding the expert's deeper insights, there are important points left to be recognized. First, the current academic standard of peer reviewed journals filled with text seems to communicate less than half of each experts' actionable knowledge on the subject. Given the incredible difficulty of the problems facing our planet, we suggest that such a low level of communication is insufficient. Second, if each publication shows only part of each expert's knowledge, then the publication process seems to support fragmentation.

To counter fragmentation (while increasing opportunities for communication and learning) we may improve our models (and our ability to communicate them) by following a few key rules: 1) Concepts/variables should be measurable. And, models should have empirical support from those measurements. If they are not, publications should (at a minimum) suggest directions for finding how they might be measured as a direction of future research. 2) Causal connections should be the only ones used between concepts. 3) IPA should be used to evaluate theoretical models for their systemic structure. 4) The results should be made into a map for more effective communication – particularly through an online platform.

To support interdisciplinary progress, the fifth rule requires that each literature review should include theories from multiple disciplines. By adopting those five key rules for reviewing submissions and choosing articles for publication, journals could contribute greatly to reducing fragmentation.

Space does not allow for a complete presentation, so I will mention only briefly here that other techniques might also be used to improve theoretical models such as "shifting the scale of abstraction" for concepts within the model (Wallis, 2014a). Also, an understanding of each model's sub-structures would also be useful (Wallis, 2014c). As would identifying the core and belt of theories to facilitate research (Wallis, 2014d) and integrating theories within and between disciplines (Wallis, 2012). Those, and other techniques, might be combined under the general heading of Causal Knowledge Mapping (CKM) and would also prove useful guides for improve journal submissions (Wallis, 2015b).

While SOCS (in general) and IPA (in particular) provide innovative, objective, and valuable approaches to improving theories so that they are more useful in practical application, there remains at least one very serious issue. Given the large size or complexity of theories needed to enable sustainable positive change in complex organizations (or nations), practitioners may be hesitant to enact change projects without additional assurances for the potential success of such a project. Such concern is justified given the frequent failure of policy initiatives (McConnell, 2016; Wallis, 2010, 2011, 2013, 2015a, c; Wallis & Valentinov, 2016b; Wallis & Wright, 2015a; Wallis & Wright, 2016; Wallis, Wright, & Nash, 2016). To alleviate such concerns, it may be useful to develop more effective computer models for testing theories (Wallis & Johnson, 2018).

Success in the Field

While the previous example focused on the synthesis of expert knowledge in academic publication, it is certainly possible (and desirable) to apply the SOCS perspective in the classroom (to support student learning) and in the field (to support practitioner success).

One client was seeking a more effective "theory of change" to inform their nation-wide work improving low-middle income neighborhoods. Their research was likely interdisciplinary, although they did not retain a list of specific sources. What they did in their research was to aggregate the results into a list of over 60 concepts that were relevant to the topic. To synthesize those concepts – to turn fragmented data into an actionable knowledge map – experts from differing parts of the organization took on the task of identifying causal links between those concepts. That combination of academic and practitioner insight resulted in a more useful knowledge map.

Success in the Classroom

To improve classroom results, Goltz (2017) used knowledge mapping to both evaluate and improve student learning at the graduate and undergraduate level. Students create knowledge maps near the start and near the end of each semester. The structure of the maps increases with the increase in actionable knowledge. While such maps might not be (strictly speaking) interdisciplinary in nature, it may be expected that students add their personal knowledge (from outside a discipline) to the disciplinary knowledge of the classroom.

Additionally, I have conducted workshops with doctoral candidates for evaluating and synthesizing theories for their literature reviews. Although, as yet, it is not certain if their synthesized theories will consist of one discipline or many.

For those interested in facilitating an interdisciplinary workshop within your own classrooms, I suggest the following general steps.

1. Drawing on reading from within and/or beyond the course material, each student writes one concept on a 5x7 card. The cards may be placed on a wall, table, or floor – where all can see them and re-arrange them as needed.

2. Students take turns identifying causal connections between concept cards. This may be done by drawing an arrow on a (new) card and placing it between two (existing) concept cards.

3. Each time an arrow is placed, ask the class to consider it and vote – does it seem like a reasonable connection? This is a good opportunity for classroom conversation.

The resulting map may be used to support course-based projects – including research. If the map turns out to be rather large, students might divide themselves into teams – with each team addressing a different "chunk" of the map. Each chunk will (hopefully) be connected to the others by causal arrows.

Other conversations might be stimulated by asking how each concept may be measured. Also, students may be encouraged to find what is "missing" from the map – either through speculation, research, or an exploration of the literature – preferably across multiple disciplines.

CONCLUSION

Using the SOCS perspective, and more specifically IPA, with its measures of Complexity and Systemicity, provides a new dimension for synthesizing theories within and between disciplines. Having a direction means we can accelerate our progress and work more purposefully to advancing our theories and practices.

IPA may be seen as a "structural" perspective of theory. That is a new and useful view because it supports interdisciplinary synthesis. However, there are limits to the structural perspective. First, it does not specifically include or evaluate the data used to create the theory – although that area is well covered by other authors (cf. Popper, 2002). Second, it does not evaluate the relevance of the theory to a situation (note that this is different from a theory of a situation). For example, although Ohm's Law is a highly structured conceptual system, it is quite useless for choosing the color of a new sofa.

Another limitation is due to the fact that IPA and SOCS are based on relatively foundational aspects of systems thinking – elements and relationships. It is entirely possible that more advanced concepts may be used to suggest more effective methods for evaluating, improving, and synthesizing interdisciplinary theories for research, practice, and collaboration. For example, Ohm's Law is structured with two loops (Figure 4).

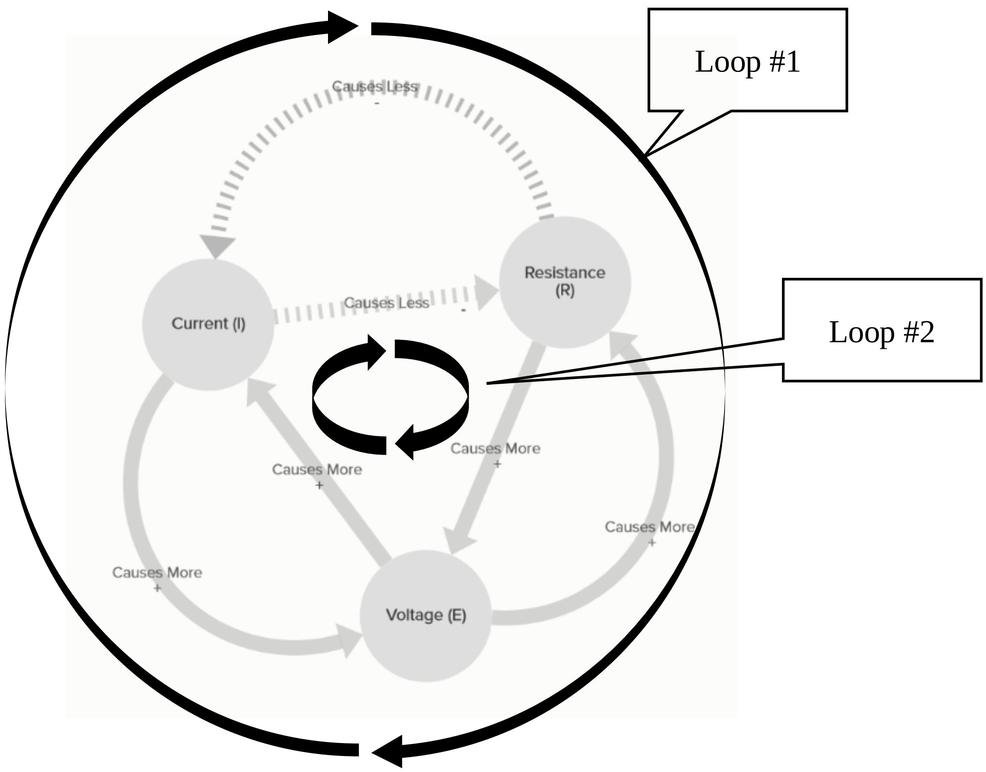

Figure 4 - Ohm's Law and its loops

Research should be started to evaluate the number of loops within theories, and relate that evaluation with the usefulness of the theory in practical application. More philosophically, we might ask how many loops are "optimal" within a theory. Ohm's law contains two loops; should a theory of more complex systems contain more?

Another potential limitation of SOCS, or at least an area for additional investigation, relates to the question of boundary conditions suggested by Churchman and developed others (Midgley, Munlo, & Brown, 1998; Velez-Castiblanco, Brocklesby, & Midgley, 2016). What problems are most pressing or most important and so should be addressed first? Who should be involved in the creation of interdisciplinary theories? SOCS does not provide an answer, although it may hint at a path forward.

While we can't answer "who," we can suggest that continued advancement means that more people will be involved – both in choosing the problems to be addressed and in developing the theory. The principles presented here may serve as a guide for the next generation of scholars and practitioners through the process of interdisciplinary collaboration to develop more useful and sustainable theories (Wallis & Valentinov, 2017) to support organizations and communities and they strive to reach their goals and avoid unanticipated consequences (Wallis & Valentinov, 2016a).

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