Is Leadership Antidisciplinary?
A Krebs Cycle of Creativity Approach With Game-Based Applications

Sanket Patel
University of San Diego

Joseph Lasley
University of Southern Maine

Leadership has been conceptualized as a complex interaction between contexts, leaders, and followers in an interdisciplinary paradigm. This paper explores a reorientation from an interdisciplinary to an antidisciplinary paradigm of leadership to help make meaning of the broad, often incongruent theories. This is proposed through the use of the Krebs Cycle of Creativity (KCC) as a novel philosophical heuristic. In practice, KCC may be used to conceptually facilitate constructive brainstorming around topics of innovation or problem solving across the disciplinary silos similar to how we used it to understand game-based leadership applications.

Keywords: leadership, antidisciplinary, krebs cycle of creativity, game-based

INTRODUCTION

Is the practice of leadership antidisciplinary in nature? If we consider leadership a complex and creative activity to mobilize people and systems in service of a purpose, can the practice of leadership be seen in harmony, despite differences across the body of literature informed by interdisciplinary research? To explore the question, this paper discusses the use of the Krebs Cycle of Creativity (KCC) to philosophically reorient paradigms in leadership research and its practice from an interdisciplinary to an antidisciplinary approach.

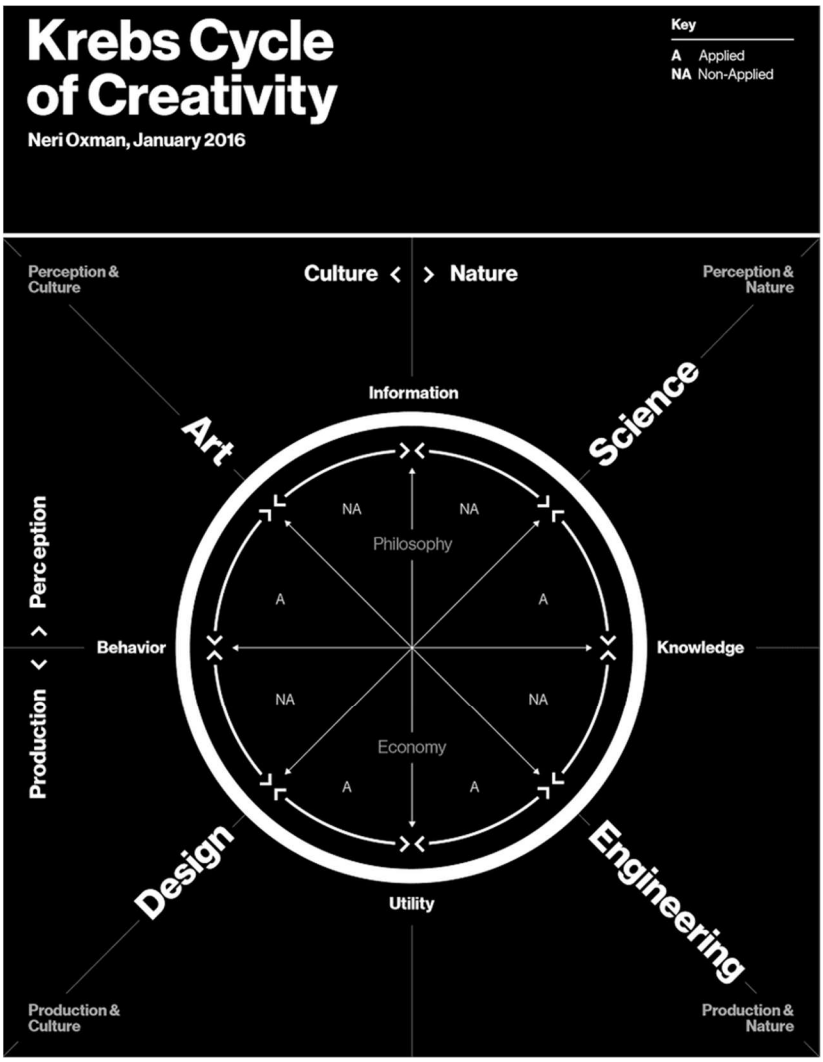
The KCC was proposed by the Massachusetts Institute of Technology Media Lab's Dr. Neri Oxman in her paper "The Age of Entanglement" (2016) and presents, as she states, an antidisciplinary hypothesis "that knowledge can no longer be ascribed to, or produced within disciplinary boundaries, but is entirely entangled." Oxman drew inspiration from the biological Krebs Cycle (Krebs, 1953), also known as the Citric Acid Cycle or the Tricarboxylic Acid Cycle that defines how chemicals are processed and metabolized in cells as a "source of energy" (Cleveland & Morris, 2015). Her application of the Krebs Cycle concept to creativity is summarized as:

> A map that describes the perpetuation of creative energy (creative ATP or 'CreATP'), analogous to the Krebs Cycle proper. In this analogy, the four modalities of human creativity—Science, Engineering, Design, and Art—replace the Krebs Cycle's carbon

compounds. Each of the modalities (or 'compounds') produces 'currency' by transforming into another (Oxman, 2016).

KCC operates in a seamless flow from science to engineering to design to art. Science turns information into knowledge used by engineering to generate utility. The utility drives design that orchestrates behavior; behavior inspires art, which produces information for scientific inquiries (Oxman, 2016); this was illustrated to give the concept a visual framework (see Figure 1).

FIGURE 1
KREBS CYCLE OF CREATIVITY



(OXMAN, 2016)

Leveraging the concept, Oxman is at the forefront of an emerging field of material ecology (Oxman, n.d.), a term coined by her where the intent is "designing with, for, and by nature" (*Group Overview ‹ Mediated Matter*, n.d.). The process of creation is envisioned as a boundaryless and deeply entangled synthesis of science, engineering, design, and art at the MIT Media Lab's Mediated Matter group (*Group Overview ‹ Mediated Matter*, n.d.). Materials from nature are engineered through advanced technology, designed in a novel approach producing works of art that have been showcased in the media and exhibits in modern art museums (Gamolina, 2020; *Neri Oxman*, 2020; Neville, 2019).

This paper (a) discusses a systems view of leadership and addresses how systemic challenges in leadership are not merely interdisciplinary, rather more deeply entangled and fundamentally antidisciplinary in nature, (b) applies KCC to provide a useful heuristic to help connect theories across history and various schools of thought in the process of reorientation, (c) uses KCC to develop an understanding of game-based leadership practice, and (d) discusses feedback from initial brainstorming and round table discussions.

LEADERSHIP AND THE KREBS CYCLE OF CREATIVITY

Leadership Theory

The history of leadership has been characterized by interdisciplinary contributions from academics and practice (Grint, 2011). Various perspectives across the breadth of social sciences have helped shape its knowledge (Bryman et al., 2011; Nahavandi, 2014; Northouse, 2018; Yukl, 2010), demonstrating the often difficult, complicated, complex and emergent nature of its study and practice (Uhl-Bien et al., 2007). A common consensus on a specific definition of leadership does not exist; however, systems-based approaches characterize leadership as an interaction of contexts, leaders, and followers in the pursuit of a purpose or goal (Kellerman, 2016; Ladkin, 2010; Schneider & Somers, 2006; Uhl-Bien et al., 2007).

To this day, the constructive tension between theories, methods, and various approaches continues (Riggio, 2018). Putting aside each theory's mechanics – philosophically, many share the common thread of leader-follower interactions within, or in relationship to, situations or contexts (Kellerman, 2016; Ladkin, 2010; Oc, 2018; Yukl, 2011). Yet, the challenge to make meaning of the total interdisciplinary body of leadership studies remain from attempts at a unifying theory bridging disciplines (Goethals & Sorenson, 2007; Kilburg & Donohue, 2011), leader or leadership development challenges (Day et al., 2014; Riggio, 2008), level of analysis challenges (Yammarino et al., 2005), or equal recognition of the systemic components such as followership (Bastardoz & Van Vugt, 2019; Riggio et al., 2008; Uhl-Bien et al., 2014) to the more contextually sensitive systems view of leadership (Kellerman, 2016; Oc, 2018). There is no single accepted approach - most would agree that "it depends." The dependency may be representative of a profoundly entangled or complex system (Uhl-Bien et al., 2007). Such complexity lends leadership paradigms to exploring the application of KCC to our many understandings of leadership.

Krebs Cycle of Creativity

As noted earlier, to explain such entanglement within the context of creativity, the KCC was proposed as a synthesis of art, science, engineering and design in "an attempt to represent the antidisciplinary hypothesis: that knowledge can no longer be ascribed to, or produced within disciplinary boundaries, but is entirely entangled" (Oxman, 2016).

Therefore, the antidisciplinary hypothesis and KCC may be used as a paradigm-shifting philosophical heuristic (Kuhn, 2012) within which the vast breadth of creative expression for leadership studies and practice can be viewed from an interdisciplinary (Bryman et al., 2011), to an antidisciplinary shift (Ito et al., 2019). If we consider leadership as a complex and creative activity to mobilize people and systems (Uhl-Bien et al., 2007), then by doing so, the totality of knowledge and practice involved in leadership may be seen with a degree of philosophical harmony, despite differences across the historical arc of leadership theory and practice (Grint, 2011). Instead of various approaches jockeying for space and the challenges that come with interdisciplinary research (Huutoniemi et al., 2010), the antidisciplinary approach is inclusive of the complex, emergent, and entangled sum of all theories. Philosophically it aligns with an intelligent, conscious, and unconscious creative expression of humanity as leadership, where we often find ourselves saying, "sometimes, it depends," to make meaning of it all. To be clear, while there is a body of research surrounding creativity and leadership (Mumford et al., 2011), the application of the KCC heuristic across leadership studies will allow for the concepts presented herein to function at an overarching level, vice bound to disciplinary approaches in noted creativity leadership studies research or practice.

FRAMING GAME-BASED LEADERSHIP WITH KCC

Leadership is experienced in practice, and one way to make meaning of this experience is through game-based leadership. Game design merges design and art both in the process of creating a game and in the behavioral experience of playing. Leadership theory and research form the scientific and knowledge base for creating games focused on a particular area of leadership development. Leadership knowledge, combined with knowledge about experiential learning and development, is applied in an engineering process (developing and facilitating workshops) to utilize games and game design in developmental and educational contexts.

Game-Based Application

Game-based leadership development is an application and example of KCC in leadership practice demonstrated by the work being done by Gamenamic Leadership Consulting LLC. Gamenamic creates and uses workshops that facilitate dynamic games designed for players to explore cognitive and experiential action learning activities as tools for developing leadership. Game-based learning allows participants to experience personal content with a growth mindset and positive emotional attractor framework (Boyatzis et al., 2015). Players have concrete experiences with the game that can be the subject of critical reflection and transformative learning (Daniau, 2016; Wasserman & Banks, 2017). The game provides enough psychological safety to confront issues that typically elicit resistance (such as acknowledging our own biases) without fully succumbing to the detrimental impact of escapism. These games facilitate an understanding of leadership and a parallel process for personal development in the play experience, with the potential to increase the self-awareness of leaders and teams.

After a design process rooted in action inquiry, facilitators guide players through the game experience, offer coaching throughout, and engage the participants in case-in-point learning. Following the game experience, a facilitated debrief prompts players to critically reflect on their development and how the mental models present in the game can contribute to learning about leadership outside the game.

Game-based leadership encompasses multiple domains in its creation, utilization, interaction, and in the experience of groups of participants being linked to leadership in broader contexts. While each component part of game-based leadership can be viewed with richness in particular disciplines, the whole application cannot be fully addressed without seeing a whole system composed of smaller wholes (Senge et al., 2005). This application of game-based leadership exemplifies an entangled system of multiple disciplines (the domains of KCC in particular) as a leadership phenomenon that is best conceptualized by an antidisciplinary, rather than multidisciplinary, heuristic.

DISCUSSIONS AND FEEDBACK

The concepts of leadership, KCC, and game-based application were discussed in a meeting with participants from a University's innovation committee (Lasley & Patel, 2020) and further at an Interactive Round Table discussion at the 2020 International Leadership Association (ILA) Virtual Global Conference (Patel & Lasley, 2020). The presentations and roundtable were oriented towards dialogue and exploration, not scientific research, yet offered insights in the application of KCC within leadership studies. In both discussions, the authors used a virtual zoom background of the famous National Aeronautics and Aerospace Administration's "earth rising" photograph of the earth from the moon, captured by the crew of Apollo 8 (NASA, 2015). The topic of seeing earth from an astronaut's perspective has been subject to coining the phrase, "the overview effect" (*The Overview Effect | KarmaTube*, n.d.). The authors felt the beauty and efforts expressed by the image captured the essence of what KCC offers to leadership practice – the ability to reorient and see whole systems with varying perspectives across art, science, engineering, and design – all of which can be associated with the Apollo space programs. Such a vantage point allows one to operate across various disciplines as interconnected ecosystems to fully appreciate what each brings to the table.

The innovation committee presentation asked participants to read Oxman's article "The Age of Entanglement" and walked through a summary of the concepts above. Then, the authors asked the

participants to walk through the idea of "making coffee" using KCC's four domains of science, engineering, design, and art in open brainstorming through a web-based collaboration tool. As everyone implemented what they knew regarding making coffee and the associated science, engineering, design, and art informing the practice (and experience) of coffee, brainstorming benefits became evident across the various domains. More importantly, in the debriefing, many vocalized how they started to see implicit connections between KCC's four domains as it related to "making coffee." One could begin in science and end up in design, engineering to art, or all the way around. Even if a particular thought started their journey in one of the four processes, participants could appreciate how the boundary was merely one for application; in reality, all ideas were deeply entangled. Some topics apparent in design were simultaneously expressing art, for example. These experiences illustrate what Oxman and others have stated regarding the KCC and its inherent ability to show an antidisciplinary perspective (Ito et al., 2019; Oxman, 2016).

The authors also engaged in an open dialogue at the ILA Virtual Global Conference with a small audience in an interactive round table discussion (Patel & Lasley, 2020). The experiences of participants were similar; visualizing the KCC heuristic in practice offered participants a way of stepping outside of the disciplinary or interdisciplinary norms. Some technology examples were discussed with the group. For example, the industrial design work of Dieter Rams summarized in his ten principles of design (*Good Design | About Us | Vitsœ*, n.d.) and what author Andrew Hargadon called the process of breakthroughs at Edison's Menlo Park lab or IDEO as an activity of "technology brokerage" across different fields (Hargadon, 2003). KCC was discussed as complementary to these concepts and others, such as IDEO's take on design thinking, models mentioned by Peter Senge's "The Fifth Discipline," or Otto Scharmer's "Theory U" (*Hello Design Thinking*, n.d.; Scharmer, 2009; Senge, 2010). One participant further noted that KCC might offer an interface between leadership practice and research, helping connect the two facets of practice and theory that are often at odds with each other.

These initial conversations encouraged and inspired co-creation around the framework of seeing leadership through the KCC heuristic and practically making meaning such as in game-based leadership.

SUMMARY

In closing, the world is complex and challenging, where humanity often faces dilemmas that require "leadership." Heifetz and others call these dilemmas adaptive challenges, where a prescriptive or technical solution may not merely be readily available (Heifetz, 1994; Heifetz et al., 2009; Heifetz & Linsky, 2002).

Approaching these ideas in an open, often cross, multi, or interdisciplinary approach is of value informed by research. However, the body of literature has identified gaps. Also, it faces broader challenges to synthesis across research in the application, often with skeptical practitioners who draw from experience and shared best practices. We offer that KCC may be useful as a heuristic where both realities are acknowledged - the antidisciplinary nature of leadership informed by interdisciplinary literature in leadership studies, wherein the reverse also applies. KCC's application in practice, as an example, can be experienced through game-based leadership or brainstorming with diverse groups in service of innovation, creativity, or tackling adaptive challenges. The concepts presented herein are nascent; therefore, they still require exploration across practice and research to refine, or challenge the conceptions.

REFERENCES

Bastardoz, N., & Van Vugt, M. (2019). The nature of followership: Evolutionary analysis and review. *The Leadership Quarterly*, *30*(1), 81–95. https://doi.org/10.1016/j.leaqua.2018.09.004

Boyatzis, R.E., Rochford, K., & Taylor, S.N. (2015). The role of the positive emotional attractor in vision and shared vision: Toward effective leadership, relationships, and engagement. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.00670

Bryman, A., Collinson, D., Grint, K., Jackson, B., & Uhl-Bien, M. (Eds.). (2011). *The SAGE Handbook of Leadership*. SAGE Publications.

Cleveland, C.J., & Morris, C.G. (Eds.). (2015). K. In *Dictionary of energy* (pp. 327–334). Elsevier. https://doi.org/10.1016/B978-0-08-096811-7.50011-1
Daniau, S. (2016). The Transformative Potential of Role-Playing Games. *Simulation & Gaming*, *47*(4), 423–444. https://doi.org/10.1177/1046878116650765
Day, D.V., Fleenor, J.W., Atwater, L.E., Sturm, R.E., & McKee, R.A. (2014). Advances in leader and leadership development: A review of 25years of research and theory. *The Leadership Quarterly*, *25*(1), 63–82. https://doi.org/10.1016/j.leaqua.2013.11.004
Gamolina, J. (2020, September 2). *Intimate Links: Neri Oxman on Designing Systems, Radical Change, and Architecture as Destiny*. Retrieved from https://www.madamearchitect.org/interviews/2020/8/31/neri-oxman
Goethals, G.R., & Sorenson, G.J. (2007). *The Quest for a General Theory of Leadership*. Edward Elgar Publishing.
Good design | About us | Vitsœ. (n.d.). Retrieved November 24, 2020, from https://www.vitsoe.com/us/about/good-design
Grint, K. (2011). A History of Leadership. In *The Sage Handbook of Leadership* (pp. 3–14). SAGE Publications.
Group Overview ‹ Mediated Matter. (n.d.). MIT Media Lab. Retrieved November 24, 2020, from https://www.media.mit.edu/groups/mediated-matter/overview/
Hargadon, A. (2003). *How breakthroughs happen: The surprising truth about how companies innovate*. Harvard Business Press.
Heifetz, R.A. (1994). *Leadership Without Easy Answers*. Harvard University Press.
Heifetz, R.A., Grashow, A., & Linsky, M. (2009). *The practice of adaptive leadership: Tools and tactics for changing your organization and the world.* Harvard Business Press.
Heifetz, R.A., & Linsky, M. (2002). *Leadership on the Line: Staying Alive Through the Dangers of Leading*. Harvard Business Press.
Hello Design Thinking. (n.d.). IDEO U. Retrieved March 18, 2018, from https://www.ideou.com/products/hello-design-thinking
Huutoniemi, K., Klein, J.T., Bruun, H., & Hukkinen, J. (2010). Analyzing interdisciplinarity: Typology and indicators. *Research Policy*, *39*(1), 79–88. https://doi.org/10.1016/j.respol.2009.09.011
Ito, J., Saltiel, N., & Uhl, A. (2019). Designing Participation Rethinking the Bauhaus's Legacy at the MIT Media Lab. In *Bauhaus Futures*. MIT Press.
Kellerman, B. (2016). Leadership–It's a *System*, Not a Person! *Daedalus*, *145*(3), 83–94. https://doi.org/10.1162/DAED_a_00399
Kilburg, R.R., & Donohue, M.D. (2011). Toward a "grand unifying theory" of leadership: Implications for consulting psychology. *Consulting Psychology Journal: Practice and Research*, *63*(1), 6–25. https://doi.org/10.1037/a0023053
Krebs, H.A. (1953, December 11). *Nobel Lecture: The citric acid cycle*. Retrieved from https://www.nobelprize.org/uploads/2018/06/krebs-lecture.pdf
Kuhn, T.S. (2012). *The Structure of Scientific Revolutions: 50th Anniversary Edition*. University of Chicago Press.
Ladkin, D. (2010). *Rethinking Leadership: A New Look at Old Leadership Questions*. Edward Elgar Publishing.
Lasley, J., & Patel, S. (2020). *Leadership and Krebs Cycle of Creativity—An Antidisciplinary View of Leadership and Game-Based Applications.* Innovation Committee Meeting, San Diego State University Academy for Professional Excellence, San Diego, California.
Mumford, M.D., Robledo, I.C., & Hester, K.S. (2011). Creativity, innovation, and leadership: Models and findings. In *The SAGE Handbook of Leadership* (pp. 405–421). SAGE Publications Ltd.
Nahavandi, A. (2014). *The Art and Science of Leadership* (7th ed.). Pearson Education.
NASA. (2015, February 23). *Earthrise* [Text]. Retrieved from http://www.nasa.gov/multimedia/imagegallery/image_feature_1249.html

Neri Oxman: Material Ecology | MoMA. (2020). Retrieved from https://www.moma.org/calendar/exhibitions/5090

Neville, M. (2019, September 25). Abstract: The Art of Design (No. 2). In *Neri Oxman: Bio-Architecture*. Netflix. Retrieved from https://www.netflix.com/title/80057883

Northouse, P.G. (2018). *Leadership: Theory and Practice*. SAGE Publications.

Oc, B. (2018). Contextual leadership: A systematic review of how contextual factors shape leadership and its outcomes. *The Leadership Quarterly*, *29*(1), 218–235. https://doi.org/10.1016/j.leaqua.2017.12.004

Oxman, N. (n.d.). *Towards a Material Ecology*. MIT Media Lab. Retrieved October 24, 2020, from https://www.media.mit.edu/publications/towards-a-material-ecology/

Oxman, N. (2016). *Age of Entanglement*. https://doi.org/10.21428/7e0583ad

Patel, S., & Lasley, J. (2020, November 8). Leadership and Krebs Cycle of Creativity—An Antidisciplinary View of Leadership and Game-Based Applications. *Interactive Round Table*. 22nd International Leadership Association (ILA) Annual Global Live Virtual Conference, San Francisco, California.

Riggio, R.E. (2008). Leadership development: The current state and future expectations. *Consulting Psychology Journal: Practice and Research*, *60*(4), 383–392. https://doi.org/10.1037/1065-9293.60.4.383

Riggio, R.E. (Ed.). (2018). *What's Wrong With Leadership?: Improving Leadership Research and Practice*. Routledge.

Riggio, R.E., Chaleff, I., & Lipman-Blumen, J. (2008). *The Art of Followership: How Great Followers Create Great Leaders and Organizations*. John Wiley & Sons.

Scharmer, C.O. (2009). *Theory U: Learning from the Future as It Emerges*. Berrett-Koehler Publishers.

Schneider, M., & Somers, M. (2006). Organizations as complex adaptive systems: Implications of Complexity Theory for leadership research. *The Leadership Quarterly*, *17*(4), 351–365. https://doi.org/10.1016/j.leaqua.2006.04.006

Senge, P.M. (2010). *The Fifth Discipline: The Art & Practice of The Learning Organization*. Crown Publishing Group.

Senge, P.M., Scharmer, C.O., Jaworski, J., & Flowers, B.S. (2005). *Presence: An Exploration of Profound Change in People, Organizations, and Society*. Crown.

The Overview Effect | KarmaTube. (n.d.). Retrieved March 4, 2018, from http://www.karmatube.org/videos.php?id=4066

Uhl-Bien, M., Marion, R., & McKelvey, B. (2007). Complexity Leadership Theory: Shifting leadership from the industrial age to the knowledge era. *The Leadership Quarterly*, *18*(4), 298–318. https://doi.org/10.1016/j.leaqua.2007.04.002

Uhl-Bien, M., Riggio, R.E., Lowe, K.B., & Carsten, M.K. (2014). Followership theory: A review and research agenda. *The Leadership Quarterly*, *25*(1), 83–104. https://doi.org/10.1016/j.leaqua.2013.11.007

Wasserman, J.A., & Banks, J. (2017). Details and Dynamics. *Simulation and Gaming*, *48*(5), 603–624. https://doi.org/10.1177/1046878117715056

Yammarino, F.J., Dionne, S.D., Uk Chun, J., & Dansereau, F. (2005). Leadership and levels of analysis: A state-of-the-science review. *The Leadership Quarterly*, *16*(6), 879–919. https://doi.org/10.1016/j.leaqua.2005.09.002

Yukl, G. (2010). *Leadership in Organizations*. Pearson.

Yukl, G. (2011). Contingency Theories of Effective Leadership. In *The SAGE Handbook of Leadership* (pp. 286–298).