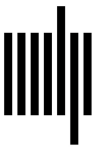
Context Changes Everything

How Constraints Create Coherence

By: Alicia Juarrero

Citation:

Context Changes Everything: How Constraints Create Coherence
By: Alicia Juarrero
DOI: 10.7551/mitpress/14630.001.0001
ISBN (electronic): 9780262374774
Publisher: The MIT Press
Published: 2023



The MIT Press

References

Abbott, A. 2018. How the brain's phase code might unlock the mysteries of perception. *Nature*, December 11.

Abraham R., and C. Shaw. 1992. *Dynamics: The geometry of behavior*. New York: Basic Books.

Adam, D. 2020. Walk this way. *NewScientist*, September 10, 36–40.

Agosta, S. J., and D. R. Brooks. 2020. *Major metaphors in evolution: Darwinism then and now*. New York: Springer.

Agosta, S., N. Janz, and D. R. Brooks. 2010. How specialists can be generalists: Resolving the parasite paradox and implications for emerging infectious diseases. *Zoologia* 27: 171–162. https://www.researchgate.net/publication/252628776_How_Specialists_Can_Be_Generalists_Resolving_the_Parasite_Paradox_and_Implications_for_Emerging_Infectious_Disease.

Ahmadian, Y., and K. Miller. 2021. What is the dynamical regime of cerebral cortex? *Neuron* 109:373–391. https//doi.org/10.1016/j.neuron.2021.07.031.

Allen, T. F. H., R. V. O'Neill, and T. W. Hoekstra. 1984. *Interlevel relations in ecological research and management: Some working principles from hierarchy theory*. USDA Forest Service Technical Report RM-110.

Allen, T. F. H., and T. B. Starr. 1982. *Hierarchy*. Chicago: University of Chicago Press.

Anderson, Philip W. 1972. More is different. *Science* 177(4047):393–396. https://doi.org/10.1126/science.177.4047.393.

Aristotle. 2022. The complete works. ATN Classics. ASIN: B08X4W3GVJ.

Arnellos, A., and A. Moreno. Cognitive functions are not reducible to biological ones: the case of minimal visual perception. *Biology and Philosophy* 37:1–25.

Arthur, B. 2020. Why does economics need this different approach? In *Complexity economics: Dialogues of the applied complexity network*, edited by B. Arthur, E. D. Beinhocker, and A. Stanger. Santa Fe, NM: SFI Press.

Arthur, B., E. D. Beinhocker, and A. Stanger, eds. 2020. *Complexity economics: Dialogues of the applied complexity network*. Santa Fe, NM: SFI Press.

Artigiani, R. 1994. Send me your refuse: The US Constitution as trash collector. *American Journal of Semiotics* 11(1/2):249–276.

Artigiani, R. 2021. Shifting paradigms: Beyond modern science to complexity and ethics. *Northern Plains Ethics Journal* 9(1):1–98.

Ashby, W. R. 1958. Requisite variety and its implications for the control of complex systems. *Cybernetica (Namur)* 1(2):1–13.

Aznar, A. 2021. Why psychologists can't decide if moral disgust is even a thing. *NewScientist* 3356. https://www.newscientist.com/article/mg25133564-300-why-psychologists-cant-decide-if-moral-disgust-is-even-a-thing/.

Barabasi, A.-L., M. Newman, and D. J. Watts. 2006. *The structure and dynamics of networks*. Princeton, NJ: Princeton University Press.

Barandiaran, X. 2008. Mental life: A naturalized approach to the autonomy of cognitive agents. PhD thesis, University of the Basque Country, Donostia-San Sebastian, Spain. https://xabierbarandiaran.files.wordpress.com/2010/06/barandiaran-2008-phd_thesis.pdf.

Barber, N. 2016. Why entrench? *International Journal of Constitutional Law* 14(2):325–350. https://doi.org/10.1093/icon/mow030.

Barbour, J. 2020. *The Janus point: A new theory of time*. London: The Bodley Head.

Barwich, A. S. 2020. *Smellosophy: What the nose tells the mind*. Cambridge, MA: Harvard University Press.

Bateson, G. 1960. *Mind and nature: A necessary unity*. New York: Ballantine Books.

Bateson, G. 1972. *Steps to an ecology of mind*. New York: Ballantine.

Bechtel, W., and J. Mundale. 1999. Multiple realizability revisited: Linking cognitive and neural states. *Philosophy of Science* 66:175–207.

Bedau, M. and P. Humphreys, eds. 2008. *Emergence: Contemporary readings in the philosophy of science*. Cambridge, MA: MIT Press.

Bejan, A. 2016. *The physics of life: The evolution of everything*. New York: St. Martin's Press.

Bejan, A. 2020. Discipline in thermodynamics. *Energies* 13:2487.

Bejan, A., and S. Lorente. 2004. The constructal law and the thermodynamics of flow systems with configuration. *International Society of Heat and Mass Transfer* 47(14–16):3203–3214.

Bejan, A., and S. Lorente. 2008. *Design with constructal theory*. New York: Wiley.

Bénard, H. 1900. Les tourbillons cellulaires dans une nappe liquide [Cellular vortices in a sheet of liquid]. *Revue Générale des Sciences Pures et Appliquées* 11:1261–1271, 1309–1328.

Bich, L., M. Mossio, and A. M. Soto. 2020. Glycemia regulation: From feedback loops to organizational closure. *Frontiers in Physiology* 11:69. https://doi.org/10.3389/phys2020.00069.

Bickhard, M. 1992. Scaffolding and self-scaffolding: Central aspects of development. In *Children's development within social contexts*, edited by L. T. Winegar and J. Valsiner, 33–52. Hillsdale, NJ: Lawrence Erlbaum.

Bloom, J. 2015. Cucumbers and fish—what is called culture. https://vimeo.com/145109744.

Bonduriansky, R., and T. Day. 2020. *Extended heredity: A new understanding of inheritance and evolution*. Princeton, NJ: Princeton University Press.

Bothwell, R.K., Brigham, J.C., Malpass, R.S. 1989. Cross-racial identification of faces. *Personality and Social Psychology Bulletin* 15:19–25.

Bourdieu, P. 1977. *Outline of a theory of practice*. Cambridge: Cambridge University Press.

Bourdieu, P. 1986. *Distinction*. New York: Routledge Classics.

Brahic, M. 2021. The Jekyll and Hyde proteins. *NewScientist* 252:48–50.

Brillouin, L. 1962. *Science and information theory*. New York: Academic Press.

Brooks, D. R. 2010. Sagas of the children of time: The importance of phylogenetic teaching in biology. *Evolution: Education and Outreach* 3:495–498.

Brooks, D. R., and E. O. Wiley. 1988. *Entropy as evolution*. 2nd ed. Chicago, IL: University of Chicago Press.

Buchler, J. 1977. Notes on a contour of natural complexes. In *Metaphysics of natural complexes*, edited by J. Buchler. New York: SUNY Press.

Burgauer, M. 2022a. Condensates. Maturity Mapping. https://maturitymapping.com/constraintregimes.

Burgauer, M. 2022b. Practice theory. https://maturitymapping.com.

Campagna, L., and S. Turbek. 2021. The geography of speciation in the Ibera seedeater. *Science*. https://www.science.org/do/10.1126/comment.762207/full/.

Campbell, D. 1974. Downward causation. In *Studies in the philosophy of biology*, edited by F. Ayala and T. Dobzhansky, 179–186. Berkeley: University of California Press.

Caporael, L. R., J. R. Griesemer, and W. C. Wimsatt, eds. 2014. *Developing scaffolds in evolution, culture, and cognition*. Cambridge, MA: MIT Press.

Carello, C., and M. T. Turvey. 2002. The ecological approach to perception. In *Encyclopedia of cognitive science*, edited by L. Nadel. London: Nature Publishing Group.

Castelvecchi, D. 2020. Beating biometric bias. *Nature* 587:347–349.

Centola, D. 2018. *How behavior spreads: The science of complex contagions*. Princeton, NJ: Princeton University Press.

Chalmers, D. 1996. *The conscious mind*. Oxford: Oxford University Press.

Chemero, A. 2003. An outline of a theory of affordances. *Ecological Psychology* 15(2):181–195.

Chemero, A. 2009. *Radical embodied cognitive science*. Cambridge, MA: MIT Press.

Chemero, A., and M. Turvey. 2007. Gibsonian affordances for roboticists. *Adaptive Behavior* 12:473–480.

Churchland, M. M., J. P. Cunningham, M. T. Kaufman, J. D. Foster, P. Nuyujujian, S. I. Ryu, and K.V. Shenoy. 2012. Neural population dynamics during reaching. *Nature* 487(7405):51–56. https://doi.org/10.1038/nature11129.

Churchland, M. M., G. Santhanam, and K. V. Shenoy. 2006. Preparatory activity in premotor and motor cortex reflects the speed of the upcoming reach. *Journal of Neurophysiology* 96:3130–3146.

Churchland, M. M., and K. V. Shenoy. 2007. Temporal complexity and heterogeneity of single-neuron activity in premotor and motor cortex. *Journal of Neurophysiology* 97:4235–4257.

Churchland, M. M., B. M. Yu, S. I. Ryu, G. Santhanam, and K. V. Shenoy. 2006. Neural variability in premotor cortex provides a signature of motor preparation. *The Journal of Neuroscience* 26:3697–3712.

Churchland, M. M., B. M. Yu, M. Sahani, and K. V. Shenoy. 2007. Techniques for extracting single-trial activity patterns from large-scale neural recordings. *Current Opinion in Neurobiology* 17:609–618.

Cilliers, P. 1998. *Complexity and postmodernism: Understanding complex systems*. London: Routledge.

Clark, A. 1996. *Being there: Putting brain and world together again*. Cambridge, MA: MIT Press.

Clark, A. 2019. *Surfing uncertainty: Prediction, action, and the embodied mind*. Oxford: Oxford University Press.

Clark, A., and D. Chalmers. 1998. The extended mind. *Analysis* 58(1):7–19.

Co, A. D., and M. P. Brenner. 2020. Tracing cell trajectories in a biofilm. *Science* 369(3031):6488. https://doi.org/10.1126/science.abd1225.

Collier, J. 2003a. Fundamental properties of self-organization. In *Causality, emergence, self-organization*, edited by V. Arshinov and C. Fuchs, 150–166. Moscow: NIA-Piroda.

Collier, J. 2003b. Hierarchical dynamical information systems with a focus on biology. *Entropy* 5:100–124.

Collier, J. 2004. Self-organization, individuation and identity. *Revue Internationale de Philosophie* 59:151–172.

Collier, J. 2005. Change and identity in complex systems. *Ecology and Society* 10(1):29. http://www.ukzn.ac.za/undphil/collier.

Collier, J. 2010. A dynamical approach to identity and diversity in complex systems. In *Complexity, difference and identity: An ethical perspective*, edited by P. Cilliers. New York: Springer.

Collier, J., and C. Hooker. 1999. Complexly organised dynamical systems. *Open Systems and Information Dynamics* 6(3):241–302. https://doi.org/10.1023/A:1009662321079.

Collier, J., and S. J. Muller. 1998. The dynamical basis of emergence in natural hierarchies. In *Emergence, complexity, hierarchy, organization, selected and edited papers from the Echo III Conference*, edited by G. L. Farre and T. Oksala. Helsinki: Acta Polytechnica Scandinavica.

Conrad, M. 1972. The importance of molecular hierarchy in information processing. In *Towards a theoretical biology*, edited by C. H. Waddington. Edinburgh: Edinburgh University Press.

Conrad, M. 1983. *Adaptability: The significance of variability from molecule to ecosystem*. New York: Plenum Press.

Conway, G. H. 1970. www.playthegameoflife.com. *Scientific American* 223:120–123. https://doi.org/10.1038/scientificamerican1070–120.

Crick, F., and C. Koch. 1990. Toward a neurobiological theory of consciousness. *Seminars in Neuroscience* 2:264–275.

Cumhaill, C., and R. Wiseman. 2022. *Metaphysical animals: How four women brought philosophy back to life*. New York: Doubleday.

Cunningham, J. P., and B. M. Yu. 2014. Dimensionality reduction for large-scale neural recordings. *Nature Neuroscience* 17(11):1500—1509.

Damasio, A. 2021. *Feeling and knowing: Making minds conscious*. New York: Pantheon.

Darden, L. 1977. Interfield theories. *Philosophy of Science* 44:43–64.

Datar, A., and N. Nicosia. 2018. Assessing social contagion in body mass index, overweight, and obesity using a natural experiment. *JAMA Pediatrics* 172(3):239–246.

Davidson, D. 1980. Mental events. In *Essays on actions and events*, 207–225. Reprint, Oxford: Clarendon Press.

Dean, M. 2020. "Religion as physics." https://u.pcloud.link/publink/show?code=XZJ4QLXZtxvmhLoA6QjrUj2jtrw1bz5S4m47, video. UCLA Center for the Study of Religion, 36:40.

Dehaene, S., and L. Naccache. 2000. Towards a cognitive neuroscience of consciousness: Basic evidence and a workspace framework. *Cognition* 79:1–37.

De Jaegher, H., and E. Di Paolo. 2007. Participatory sense-making: An enactive approach to social cognition. *Phenomenology and the Cognitive Sciences* 6(4):485–507. https://doi.org/10.1007/s11097-007-9076-9.

Demming, A. 2020. Analogue comeback. *NewScientist*, July 25, 37–40.

Depew, D., and B. Weber. 1995. *Darwinism evolving: Systems dynamics and the genealogy of natural selection*. Cambridge, MA: MIT Press.

Di Paolo, E., T. Buhrmann, and X. Barandiaran. 2017. *Sensorimotor life: An enactive proposal*. Oxford: Oxford University Press.

Donald, M. 1991. *Origins of the modern mind*. Cambridge, MA: Harvard University Press.

Donne, J. 1611. *An anatomy of the world*. https://www.bartleby.com/357/169.html.

Dreyfus, H. 1972. *What computers can't do: The limits of artificial intelligence*. Cambridge, MA: MIT Press.

Dyson, F. 2001. Is life analog or digital? Edge.org. https://www.edge.org/conversation/freeman_dyson-is-life-analog-or-digital.

Dyson, G. 2011. What scientific concept would improve everybody's cognitive toolkit? Edge.org. https://www.edge.org/response-detail/10105.

Dyson, G. 2012. *Turing's cathedral*. New York: Vintage.

Dyson, G. 2019. edge.org. https://www.edge.org/conversation/george_dyson-child hoods-end.

Earley, J. 1981. Self-organization and agency. In chemistry and process philosophy. *Process Studies* 11:242–258.

Edelman, G. 1987. *Neural Darwinism*. New York: Basic Books.

Edelman, G., and G. Tononi. 2000. *A universe of consciousness: How matter becomes imagination*. New York: Basic Books.

Egbert, M., and X. Barandiaran. 2014. Modeling habits as self-sustaining patterns of sensorimotor behavior. *Frontiers in Human Neuroscience* 8:1–15.

Eigen, M. 1971. Self-organization of matter and the evolution of biological macromolecules. *Die Naturwissenschaften* 58(10):465–523.

Eldredge, N. 2015. *Eternal ephemera*. New York: Columbia University Press.

Ellis, G. F. R. 2012. On the limits of quantum theory: Contextuality and the quantum-classical cut. *Annals of Physics* 327:1890–1932.

Ellis, G. F. R. 2016. *How can physics underlie the mind?* New York: Springer.

Ellis, G. F. R. 2021. Physical, logical, and mental top-down effects. In *Top down causation and emergence*, edited by J. Voosholz and M. Gabriel. Cham, Switzerland: Springer.

Etxeberria, A., and J. Umerez. 2013. Organization. In *Encyclopedia of systems biology*, edited by W. Dubitsky, O. Workenhauer, H. Yokata, and H. Cho. New York: Springer. https://doi.org/10.1007/978-1-4419-9863-7_77.

Feigl, H. 1958. The "mental" and the "physical." In *Concepts, theories and the mind-body problem*, edited by H. Feigl, M. Scriven, and G. Maxwell. Vol. 2. Minneapolis: Minnesota Studies in the Philosophy of Science.

Feynman, R. 1967. *The character of physical law*. Cambridge, MA: MIT Press.

Figdor, C. 2010. Neuroscience and the multiple realization of cognitive functions. *Philosophy of Science* 77(3):419–456.

Fodor, J. 1981. What psychological states are not. In *Representations*, 79–99. Cambridge, MA: MIT Press.

Freeman, W. J. 1991a. Nonlinear dynamics in olfactory information processing. In *Olfaction*, edited by J. Davis and H. Eichenbaum. Cambridge, MA: MIT Press.

Freeman, W. J. 1991b. The physiology of perception. *Scientific American*, February, 78–85.

Friston, K. The free-energy principle: A unified brain theory. *Nature Reviews Neuroscience* 11:127–138.

Friston, K., J. G. Tononi, G. N. Reeke, O. Spons, and G. M. Edelman. 1994. Value-dependent selection in the brain: Simulation in a synthetic neural model. *Neuroscience* 59(2):229–243.

Gardner, M. 1970. The fantastic combinations of John Conway's new solitaire game "life" (PDF). Mathematical Games. *Scientific American* 223(4):120–123. https://doi.org/10.1038/scientificamerican1070-120.

Gare, A. 2019. Biosemiosis and causation. Defending biosemiotics through Rosen's theoretical biology, or integrating biosemiotics and anticipatory systems theory. *Cosmos and History* 15(1):31–90.

Gatlin, L. 1972. *Information and the living system*. New York: Columbia University Press.

Gershenson, C. 2020. Guiding the self-organization of cyber-physical systems. *Frontiers in Robotics and AI*, April 3, 2020. https://doi.org/10.3389/frobt.2020.00041.

Gibson, J. J. 1975. Affordances and behavior. In *Reasons for realism: Selected essays of James J. Gibson*, edited by E. S. Reed and R. Jones, 410–411. Hillsdale, NJ: Lawrence Erlbaum.

Gilbert, S. 1991. Epigenetic landscaping: Waddington's use of cell fate bifurcation diagrams. *Biology and Philosophy* 6:135–154.

Gill, M., and J. Lennox, eds. 1994. *Self-motion: from Aristotle to Newton*. Princeton, NJ: Princeton University Press.

Gillett, C. 2003. The metaphysics of realization, multiple realizability, and the special sciences. *Journal of Philosophy* 100(11):591–603.

Gillett, C. 2016. *Reduction and emergence in science and philosophy*. Cambridge: Cambridge University Press.

Goldman, A. 1970. *A theory of human action*. Englewood Cliffs: Prentice Hall.

Goodwin, B. C., and M. H. Cohen. 1969. A phase shift model for the spatial and temporal organization of developing systems. *Journal of Theoretical Biology* 25(1):49–107.

Gould, S.J., and R.C. Lewontin. 1979. The spandrels of San Marco and the Panglossian paradigm: A critique of the adaptationist programme. *Proceedings of the Royal Society of London B* 205:581–598.

Grene, M. 1974. *The understanding of nature: Essays in the philosophy of biology*. Dordrecht, Netherlands: Springer.

Grobstein, C. 1973. Hierarchical order and neogenesis. In *Hierarchy theory: The challenges of complex systems*, edited by H. H. Pattee. New York: Braziller.

Guo, P. Z., L. D. Mueller, and F. J. Ayala. 1991. Evolution of behavior by density-dependent natural selection. *Proceedings of the National Academy of Science* 88(23):10905–10906. https://doi.org/10.1073/pnas.88.23.10905.

Haken, H. 1996. Slaving principle revisited. *Physica D: Nonlinear Phenomena* 97:95–103.

Haken, H., and J. Portugali. 2021. *Synergetic cities: Information, steady state and phase transition*. New York: Springer.

Haken, H., and A. Wunderlin. 1988. The slaving principle of synergetics—an outline. In *Order and chaos in nonlinear physical systems, edited by S. Lundqvist, N.H. March, and M.P. Tosi*, 457–463. Boston: Springer.

Halloran, M. E., and C. J. Struchiner. 1991. Study designs for dependent happenings. *Epidemiology* 2(5):331–338.

Halpern, P. 2020. *Synchronicity: The epic quest to understand the quantum nature of cause and effect*. New York: Basic Books.

Hatna, E., and I. Benenson. 2012. The Schelling model of ethnic residential dynamics: Beyond the integrated-segregated dichotomy of patterns. *Journal of Artificial Societies and Social Simulation* 15(1):6. https://jasss.soc.surrey.ac.uk/15/1/6.html.

Henrich, J. 2016. *The secret of our success: How culture is driving human evolution, domesticating our species, and making us smarter*. Princeton, NJ: Princeton University Press.

Heyer, R., C. Semmier, and A. Hendrickson. 2018. Humans and algorithms for facial recognition: The effects of candidate list length and experience on performance. *Journal of Applied Research in Memory and Cognition* 7:597–609.

Hinton, G. E., and T. Shallice. 1991. Lesioning an attractor network: Investigations of acquired dyslexia. *Psychological Review* 98(1):74–95.

Hinton, G. E., and R. R. Salakhutdinov. 2006. Reducing the dimensionality of data with neural networks. *Science* 313(5786):504–507.

Hoffmann, P. 2012. *Life's ratchet: How molecular machines extract order from chaos*. New York: Basic Books.

Hoffmeyer, J.-H. 2017. Basic biological anticipation. In *Handbook of anticipation*, edited by R. Poli. Cham, Switzerland: Springer International.

Hoffmeyer, J.-H. 2018. Causation, constructors, and codes. *Biosystems* 164: 121–127.

Hofstadter, D. 1979. *Gödel, Escher and Bach*. New York: Basic Books.

Holmes, B. 2019. The Goldilocks planet. *NewScientist* 24(3222):34–37.

Hone, T. 2018. *Learning war: The evolution of fighting doctrine in the U.S. Navy, 1898–1945*. Annapolis, MD: Naval Institute Press.

Humphries, M. 2021. *The spike: An epic journey through the brain in 2.1 seconds*. Princeton, NJ: Princeton University Press.

Hunt, H., J. Jinn, L. Jacobs, and R. Full. 2021. Acrobatic squirrels learn to leap and land on tree branches without falling. *Science* 373:697–700.

Hutto, D., M. Kirchhoff, and E. Myin. 2014. Extensive enactivism: Why keep it all in? *Frontiers in Neuroscience* 8:706.

Irwin, G. G., K. R. Williams, D. G. Kerwin, H. von Lieresund Wilkau, and K. M. Newell. 2021. Learning the high bar longswing: II. Energetics and the emergence of the coordination pattern, *Journal of Sports Sciences* 39(23):2698–2705. https://doi.org/10.1080/02640414.2021.1953829.

Jablonka, E., and M. J. Lamb. 2002. The changing concept of epigenetics. *Annals of the New York Academy of Sciences* 981(1):82–96.

Jacobs, J. 1993. *The death and life of great American cities*. New York: Random House.

Jantsch, E. 1980. *The Self-organizing universe*. Oxford: Pergamon.

Juarrero, A. 1991. Fail-safe versus safe-fail: Suggestions toward an evolutionary model of justice. *Texas Law Review* 69:1745–1777.

Juarrero, A. 1992. The message whose message it is that there is no message (in special Comparative Literature issue on *Foucault's Pendulum*, with commentary by U. Eco). *Modern Language Notes (MLN)* 107:892–894.

Juarrero, A. 1993. Des racines modernes aux rhizomes post-modernes (From modern roots to postmodern rhizomes). *Diogene* 163:29–48.

Juarrero, A. 1999. *Dynamics in action: Intentional behavior as a complex system*. Cambridge, MA: MIT Press.

Juarrero, A. 2004. Self-organization, individuation and identity. *Revue Internationale de Philosophie* 59:151–172.

Juarrero, A. and C. Rubino, eds. 2010. *Emergence, complexity and self-organization: Precursors and prototypes*. Boston: ISCE Publishing.

Juarrero-Roque, A. 1985. Self-organization: Kant's concept of teleology and modern chemistry. *The Review of Metaphysics* 39:107–135.

Jumper, J., R. Evans, A. Pritzel, et al. 2021. Highly accurate protein structure prediction with AlphaFold. *Nature* 596:583–589. https://doi.org/10.1038/s41586-021-03819-2.

Kauffman, S. 2014. Prolegomenon to patterns in evolution. *Biosystems* 123:3–8. https://doi.org/ 10.1016/j.biosystems.2014.03.004.

Kaufman, M. T., M. M. Churchland, S. Ryu, and K. V. Shenoy. 2014. Cortical activity in the null space: permitting preparation without movement. *Nature Neuroscience* 17(3):440–448. https://doi.org/10:1038/nn.3643.

Kelso, J. A. S. 1995. *Dynamic patterns: The self-organization of brain and behavior*. Cambridge, MA: MIT Press.

Kelso, J. A. S. 2008. Synergies: Atoms of brain and behavior. In *A multidisciplinary approach to motor control*, edited by D. Sternad. Heidelberg: Springer.

Kelso, J. A. S. 2009. Coordination dynamics. In *Encyclopedia of complexity and systems sciences*, edited by R.A. Meyers. Berlin: Springer-Verlag.

Kim, J. 1989. The myth of nonreductive materialism. *Proceedings and Addresses of the American Philosophical Association* 63(3):31–47.

Kim, J. 1998. *Mind in a physical world*. Cambridge, MA: MIT Press.

Kirschner, M. W., and J. C. Gerhart. 2005. *The plausibility of life: Resolving Darwin's dilemma*. New Haven, CT: Yale University Press.

Koch, C. 2004. *The quest for consciousness: A neurobiological approach*. Englewood, CO: Roberts and Company Publishers.

Koestler, A. 1968. *The ghost in the machine*. New York: Macmillan.

Kruesi, Liz. 2013. The cosmos' hidden scaffolding. *Astronomy*. https://astronomy.com/magazine/2013/07/the-cosmos-hidden-scaffolding.

Kurth, C. 2021. Disgust can be morally valuable. *Scientific American*. https://www.scientificamerican.com/article/disgust-can-be-morally-valuable/.

Kyselo, M. 2014. The body social: An enactive approach to the self. *Frontiers in Psychology* 5:986.

Kyselo, M., and W. Tschacher. 2014. An enactive and dynamical systems theory account of dyadic relationships. *Frontiers in Psychology* 5:452.

Ladyman, J., and D. Ross, with D. Spurrett and J. Collier. 2010. *Every thing must go*. Oxford: Oxford University Press.

Lange, M. 2007. Laws and meta-laws of nature: Conservation laws and symmetries. *Studies in History and Philosophy of Modern Physics* 38:457–481.

Lange, M. 2017. *Because without cause: Non-causal explanations in science and mathematics*. New York: Oxford University Press.

Laughlin, R., and D. Pines. 2000. The theory of everything. *Proceedings of the National Academy of Sciences* 97:28–31.

Lenton, T., and B. Latour. 2018. Gaia 2.0. *Science* 361(6407):1066–1068. https://doi.org/10.1126/science.aau0427.

Lenton, T. M., S. Daines, J. Dyke, A. Nicholson, D. Wilkinson, and H. Williams. 2018. Selection for Gaia across multiple scales. *Trends in Ecology and Evolution* 33(8):633–645. https://doi.org/10.1016/j.tree.2018.05.006.

Levins, R. 1973. The limits of complexity. In *Hierarchy theory*, edited by H. H. Pattee. New York: Braziller.

Lipscomb, B. J. B. 2021. *The women are up to something: How Elizabeth Anscombe, Philippa Foot, Mary Midgley, and Iris Murdoch revolutionized ethics*. Oxford: Oxford University Press.

Lustgarten, A. 2022. The Barbados rebellion. *New York Times Magazine*. https://www.nytimes.com/interactive/2022/07/27/magazine/barbados-climate-debt-mia-mottley.html.

MacIntyre, A. 2007. *After virtue*. Notre Dame, IN: University of Notre Dame Press.

Mante, V., D. Sussillo, K. V. Shenoy, and W. T. Newsome. 2013. Context-dependent computation by recurrent dynamics in prefrontal cortex. *Nature* 503(7474):78–84. https://doi.org/10.1038/nature12742.

Marshall, M. 2021. How water makes life possible. *NewScientist*, January 23, 15.

Martone, Robert. 2020. Music synchronizes the brains of performers and their audience. *Scientific American*. https://www.scientificamerican.com/article/music-synchronizes-the-brains-of-performers-and-their-audience/?print=true.

Mason, P. H., J. F. Dominguez, B. Winter, and A. Grignolio. 2014. Hidden in plain view: Degeneracy in complex systems. *Biosystems* 128:1–8. https://doi.org/10.1016/j.biosystems.2014.12.003.

Maturana, H., and F. Varela. 1979. *Autopoiesis and cognition: The realization of the living*. Dordrecht, Netherlands: D. Reidel Publishing.

Maury, C. P. J. 2018. Amyloid and the origin of life: self-replicating catalytic amyloids as prebiotic informational and protometabolic entities. *Cellular and Molecular Life Sciences* 75:1499–1507. https:/doi.org/10.1007/s00018-18-2797.9.

Maynard Smith, J., and E. Szathmary. 1995. *The major transitions in evolution*. Oxford: Oxford University Press.

Mazzucato, M. 2020. *The value of everything*. New York: Public Affairs Books.

McCulloch, W. 1945. A heterarchy of values determined by the topology of nervous nets. *Bulletin of Mathematical Biophysics* 7(2):89–93.

McMullin, B. 1999. Some remarks on autocatalysis and autopoiesis. http://www.eeng.dcu.ie/-mcmullin/.

McMullin, B. 2000. Remarks on autocatalysis and autopoiesis. *Annals of the New York Academy of Sciences* 901:163–174.

Medzhitov, R. 2021. The spectrum of inflammatory responses. *Science* 374(6571):1070–1075. https://doi.org/10.1126/science.abi5200.

Metzinger, T., ed. 2000. *Neural correlates of consciousness: Empirical and conceptual questions*. Cambridge, MA: MIT Press.

Mitchell, M. 2021. Why AI is harder than we think. arXiv:2104.12871v2 [cs.AI].

Montevil, M., and M. Mossio. 2015. Biological organization as closure of constraints. *Journal of Theoretical Biology* 372:179–191.

Moreno A., and M. Mossio. 2015. *Biological autonomy: A philosophical and theoretical inquiry. New York: Springer*.

Mossio, M. 2013. Closure, causal. In *Encyclopedia of systems biology*, edited by W. Dubitzky, O. Wolkenhauer, K.-H. Cho, and H. Yokota, 415–418. New York: Springer.

Murphy, N., and W. Brown. 2007. *Did my neurons make me do it*. Oxford: Oxford University Press.

Murphy, N., G. F. R. Ellis, and T. O'Connor, eds. 2009. *Downward causation and the neurobiology of free will*. New York: Springer.

Nagel, T. 1986. *The view from nowhere*. Oxford: Oxford University Press.

Nicolis, G., and I. Prigogine. 1977. *Self-organization in nonequilibrium systems*. New York: Wiley.

Noe, A. 2010. *Out of our heads: Why you are not your brain, and other lessons from the biology of consciousness*. New York: Hill and Wang.

Nordholm, S., and G. B. Bacskay. 2020. The basics of covalent bonding in terms of energy and dynamics. *Molecules* 25:2667. https://doi.org/10.3390/molecules25112667.

Pascal, R., and A. Pross. 2015. Stability and its manifestation in the chemical and biological words. *ChemComm* 51:16160–16165.

Pattee, H. H. 1972a. Laws and constraints, symbols and languages. In *Towards a theoretical biology*, edited by C. H. Waddington. Vol. 4. Edinburgh: Edinburgh University Press.

Pattee, H. H. 1972b. The evolution of self-simplifying systems. In *The relevance of general systems theory*, edited by E. Laszlo, 31–42. New York: Braziller.

Pattee, H. H. 1973. The physical basis and origin of hierarchical control. In *Hierarchy theory: The challenge of complex systems*. New York: Braziller.

Pattee, H. H. 1978. Biological systems theory: Descriptive and constructive complementarity. In *Applied general systems research*, edited by G. J. Klir, 511–520. New York: Plenum.

Pattee, H. H. 1982. Cell psychology: An evolutionary approach to the symbol-matter problem. *Cognition and Brain Theory* 4:325–341.

Patten, B., and G. Auble. 1980. Systems approach to the concept of niche. *Synthese* 43(1):155–181.

Pearl, J. 2009. *Causality: Models, reasoning and inference*. Cambridge: Cambridge University Press.

Pendleton-Jullian, A. 2020. Coming of Age: From frameworks and theories of change to scaffolds for ecologies of change. In *Cynefin: Weaving sense-making into the fabric of our world*, edited by R. Greenberg and B. Bertsch. Singapore: Cognitive Edge.

Pendleton-Jullian, A., and J. S. Brown. 2016. *Pragmatic imagination*. San Francisco: Blurb Press.

Perry, J. 2002. *Identity, personal identity, and the self*. Indianapolis, IN: Hackett.

Place, U. T. 1956. Is consciousness a brain process? *British Journal of Psychology* 47:44–50.

Plaut, D. C., and T. Shallice. 1993. Deep dyslexia: A case study of connectionist neuropsychology. *Cognitive Neuropsychology* 10:377–500.

Polger, T. W., and L. A. Shapiro. 2016. *The multiple realization book*. New York: Oxford University Press.

Prigogine, I., and I. Stengers. 1984. *Order out of chaos: Man's new dialogue with nature*. Toronto: Bantam.

Pross, A. 2012. *What is life?: How chemistry becomes biology*. New York: Oxford University Press.

Pross, A., and R. Pascal. 2013. The origin of life: What we know, what we can know and what we will never know. *Open Biology* 3. https://doi.org/10.1098/rsob.120190.

Putnam, H. 1967. Psychological predicates. In *Art, mind, and religion*, edited by W. H. Capitan and D. D. Merrill, 37–48. Pittsburgh: University of Pittsburgh Press.

Putnam, H. 1975. The meaning of "meaning." *Language, Mind, and Knowledge* 7:131–193.

Rampino, M. R., K. Caldeira, and Y. Zhu. 2021. The earth has a pulse: A 27.5 Myr underlying cycle in coordinated geological events over the last 260 Myr. *Geoscience Frontiers 12(6)*. https://doi.org/10.1016/j.gsf.2021.101245.

Ravilious, K. 2021. The last human. *NewScientist* 27:41.

Rayleigh, Lord. 1916. On the convective currents in a horizontal layer of fluid when the higher temperature is on the underside. *Philosophical Magazine* 32(192):529–546.

Regalado, A. 2019. Chinese scientists have put human brain genes in monkeys—and yes, they may be smarter. MIT Technology Review. https://www.technologyreview.com/2019/04/10/136131/chinese-scientists-have-put-human-brain-genes-in-monkeysand-yes-they-may-be-smarter/.

Ricci-Tam, C., I. Ben-Zion, J. Wang, J. Palme, and A. Li. 2021. Decoupling transcription factor expression and activity enables dimmer switch gene regulation. *Science* 372(6539):292–295. https://doi.org/10.1126/science.aba/7582.

Roque, A. J. 1987. Does action theory rest on a mistake? *Philosophy Research Archives* 13:587–612.

Rorty, R. 1982. *Consequences of pragmatism: Essays 1972–1980*. Minneapolis: University of Minnesota Press.

Rosen, R. 1985. *Anticipatory systems*. Pergamon Press.

Rosenberg, Alexander. 2001. On multiple realization and the special sciences. *The Journal of Philosophy* 98:365–373.

Rosenblueth, A., N. Wiener, and J. Bigelow. 1943. Behavior, purpose and teleology. *Philosophy of Science* 10:18–24.

Ross, R. 1916. An application of the theory of probabilities to the study of *a priori* pathometry, Part 1. *Proceedings of the Royal Society Series A* 92(638): 204–230.

Rovelli, C. 2018. *The order of time*. New York: Riverhead.

Rowlands, M. 2010. The mind embedded. In *The new science of the mind: From extended mind to embodied phenomenology*. Cambridge, MA: MIT Press.

Ruiz-Mirazo, K., and A. Moreno. 2004. Basic autonomy as a fundamental step in the synthesis of life. *Artificial Life* 10(3):235–259.

Ryle, G. 1949. *The concept of mind*. Chicago: University of Chicago Press.

Saberi, M., H. Hamedmoghadam, M. Ashfaq, et al. 2020. A simple contagion process describes spreading of traffic jams in urban networks. *Nature Communications* 11:1616. https://doi.org/10.1038/s41467-020-15353-2.

Salthe, S. 1991. Varieties of emergence. *World Futures* 21(2):69–73.

Salthe, S. 1980. Robustness, reliability and multiple determinism in science: The nature and variety of a powerful family of problem-solving heuristics. In *Knowing and validating in the social sciences: A tribute to Donald T. Campbell*, edited by M. Brewer and B. Collins. San Francisco: Jossey-Bass.

Salthe, S. 1985. *Evolving hierarchical systems*. New York: Columbia University Press.

Salthe, S. 1993. *Development and evolution: Complexity and change in biology*. Cambridge, MA: MIT Press.

Salthe, S. 2001. Summary of the principles of hierarchy theory. https://www.nbi.dk/~natphil/salthe/Summary_of_the_Principles_o.pdf.

Salthe, S. 2010. Maximum power and maximum entropy production: Finalities in nature. *Cosmos and History: The Journal of Natural and Social Philosophy* 6(1):114–121.

Salthe, S. 2012. Hierarchical structures. *Axiomathes* 22:355–383. https://doi.org/10.1007/s10516-012-9185-0.

Salthe, S. N. 2015. What actually is a living system materially? *Biological Theory 11:50–55*. https://doi.org/10.1007/s13752-015-0230-2.

Salthe, S. 2018. Perspectives on natural philosophy. *Philosophies* 3(23):35–44. https://doi.org/10:3390/philosophies3030023.

Sancar, A., and R. N. Van Gelder. 2021. Clocks, cancer and chronochemotherapy. *Science* 371(6524):42. https://doi.org/10.1126/science.abb0738.

Sawyer, R. 2005. *Social emergence: Societies as complex systems*. Cambridge: Cambridge University Press.

Schelling, T. C. 1971. Dynamic models of segregation. *Journal of Mathematical Sociology* 1(2):143–186.

Searle, J. 1980. Minds, brains and programs. *Behavioral and Brain Sciences* 3:417–457.

Shannon, C., and W. Weaver. 1949. *The mathematical theory of communication*. Champaign: University of Illinois Press.

Shapere, D. 1982. The concept of observation in science and philosophy. *Philosophy of Science* 49(4):485–525.

Shapiro, L. A. 2000. Multiple realizations. *The Journal of Philosophy* 97(12):635–654. https://doi.org/10.2307/2678460.

Shaw, R. and M. T. Turvey. 1981. Coalitions as models for ecosystems: A realist perspective on perceptual organization." In *Perceptual organization,* edited by M. Kubovy and J. Pomerantz, 343–416. Hillsdale: Lawrence Erlbaum.

Sheehy, J. 2015. There is no now. *Communications of the ACM* 58:36–41.

Shenoy, K. V., M. T. Kaufman, M. Sahani, and M. M. Churchland. 2011. A dynamical systems view of motor preparation: Implications for neural prosthetic system design. *Progress in Brain Research* 192:33–58.

Shiller, R. J. 2019. *Narrative economics: How stories go viral and drive major economic events*. Princeton, NJ: Princeton University Press.

Simon, H. 1969. The architecture of complexity. In *The sciences of the artificial*. Cambridge, MA: MIT Press.

Simon, H. 1973. The organization of complex systems. In *Hierarchy theory: The challenge of complex systems*, edited by H. H. Pattee. New York: Braziller.

Slaby, J., and G. Gallagher. 2015. Critical neuroscience and socially extended minds. *Theory, Culture and Society* 32(1):35–59.

Smart, J. J. C. 1959. Sensations and brain processes. *Philosophical Review* 68:141–156.

Snowden, D. 2015. Naturalizing sensemaking. In *Informed by knowledge: Expert performance in complex situation*, edited by K. Mosier and U. Fischer, 223–234. New York: Routledge.

Snowden, D. 2020. Cynefin: A tale that grew in the telling. In *Cynefin: Weaving sense-making into the fabric of our world*, edited by R. Greenberg and B. Bertsch. Singapore: Cognitive Edge_The Cynefin Co.

Snowden, D., and A. Pendleton-Jullian. 2020. Scaffolding. https://cdn.cognitive-edge.com/wp-content/uploads/sites/7/2020/04/22082941/c-CognitiveEdge_Scaffolding.pdf.

Steiner, P. 2019. Brain fuel utilization in the developing brain. *Annals of Nutrition and Metabolism* 19(75, suppl. 1):8–18.

Stenz, L., D. S. Schechter, S. R. Serpa, and A. Paoloni-Giacolino. 2018. Intergenerational transmission of DNA methylation signatures associated with early life stress. *Current Genomics* 19(8):665–675.

Subbaraman, Ni. 2021. First monkey-human embryos reignite debate over hybrid animals. *Nature* 592:497.

Thelen, E., and L. B. Smith. 1994. *A dynamic systems approach to the development of cognition and action*. Cambridge, MA: MIT Press.

Thom, R. 1989. *Structural stability and morphogenesis: An outline of a general theory of models*. Reading, MA: Addison-Wesley.

Thomas, A., B. Woo, D. Nettle, E. Spelke, and R. Saxe. 2022. Early concepts of intimacy. *Science* 375(6578):311–315.

Tononi, G. 2012. *Phi: A voyage from the brain to the soul*. New York: Pantheon.

Tononi, G. 2008. Consciousness as integrated information: A provisional manifesto. *Biological Bulletin* 215:216–242.

Toulmin, S. 1990. *Cosmopolis: The hidden agenda of modernity*. New York: Free Press.

Turbek, S., M. Browne, A. S. Di Giacomo. 2021. Rapid speciation via the evolution of pre-mating isolation in the Iberá Seedeater. *Science* 371:6536.

Turing, A. 1936. On computable numbers, with an application to the Entscheidungsproblem. *Proceedings of the London Mathematical Society* (Series 2) 42:230–265.

Turner, T. L., M. W. Hahn, and S. V. Nuzhdin. 2005. Genomic islands of speciation in *Anopheles gambiae*. *PLoS Biology 3*:e285.

Turvey, M. 1990. Coordination. *American Psychologist* 45:938–953.

Turvey, M. T., K. Shockley, and C. Carello. 1999. Affordance, proper function, and the physical basis of perceived heaviness. *Cognition* 17:B17–B26.

Ulanowicz, R. 1997. *Ecology: The ascendent perspective*. New York: Columbia University Press.

van Gulick, R. 1993. Who's in charge here and who's doing all the work? In *Essays on mental causation*, edited by J. Heil and A. Mele, 233–256. Oxford: Oxford University Press.

van Gulick, R. 2004. Higher-order global states (HOGS): An alternative higher-order model of consciousness. In *Higher-order theories of consciousness: An anthology*, edited by R. J. Gennaro. Amsterdam: John Benjamins.

Van Orden, G. C., J. G. Holden, and M. T. Turvey. 2003. Self-organization of cognitive performance. *Journal of Experimental Psychology: General* 132(3):331.

Varela, F., and E. Thomson. 2003. Neural synchronicity and the unity of mind: A neurophenomenological perspective. In *The unity of consciousness: Binding, integration, and dissociation*, edited by A. Cleermans. Oxford: Oxford University Press.

Voosholz, J., and M. Gabriel, eds. 2021. *Top-down causation and emergence*. Cham, Switzerland: Springer.

Vygotsky, L. 1978. *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Waddington, C. 1968–1972. *Towards a theoretical biology*. 4 vols. Edinburgh: Edinburgh University Press.

Wagner, A. 2005. *Robustness and evolvability in living systems*. Princeton, NJ: Princeton University Press.

Wagner, A. 2014. *Arrival of the fittest: Solving evolution's greatest puzzle*. New York: Penguin.

Weiss, P. 1971. The basic concept of hierarchic systems. In *Hierarchically organized systems in theory and practice*, edited by P. Weiss. New York: Hafner.

Wheeler, J. A. 2000. *Geons, black holes and quantum foam: A life in physics*. Rev. ed. New York: W. W. Norton.

Wilson, C. 2020. The mystery of mistletoe's missing genes. *QuantaMagazine*. https://www.quantamagazine.org/the-mystery-of-misteltoes-missing-genes-20201221/.

Wimsatt, W. C. 1974. Reductive explanation: a functional account. *Proceedings of the Biennial Meeting of the Philosophy of Science Association* 1974:671–710. http://www.jstor.org/stable/495833.

Wimsatt, W. C. 1976. Reductionism, levels of organization, and the mind-body problem. In *Consciousness and the brain: A scientific and philosophical inquiry*, edited by G. G. Globus, G. Maxwell, and I. Sarodnik. New York: Plenum.

Wimsatt, W. C. 2001. Generative entrenchment and the developmental systems approach to evolutionary process. In *Cycles of contingency: Developmental systems and evolution*, edited by S. Oyama, R. Gray, and P. Griffiths. Cambridge, MA: MIT Press.

Wimsatt, W. C. 2007. *Reengineering philosophy for limited beings*. Cambridge, MA: Harvard University Press.

Woods, D. D. 2016. Resilience as graceful extensibility. In *IRGC resource guide on resilience*. Lausanne: EPFL International Risk Governance Center. v29-07-2016. https://www.irgc.org/riskgovernance/resilience/.

Woods, D. D. 2018. The theory of graceful extensibility. *Environment Systems and Decisions* 38:433–457.

Wright, L. 1976. *Teleological explanations*. Berkeley: University of California Press.

Yang, T., M. Hudson, and N. Afshordi. 2020. How dark are filaments in the cosmic web. https://arxiv.org/abs/2001.10943.

Yu, B. M., A. Afshar, G. Santhanam, S. I. Ryu, K. V. Shenoy, and M. Sahani. 2006. Extracting dynamical structure embedded in neural activity. *Advances in Neural Information Processing Systems* 18:1545–1552.

Zhou, L., G. B. Melton, S. Parsons, and G. Hripcsak. 2005. A temporal constraint structure for extracting temporal information from clinical narrative. *Journal of Biomedical Informatics* 39:424–439.

This book was set in Sabon by Westchester Publishing Services.

Library of Congress Cataloging-in-Publication Data

Names: Juarrero, Alicia, author.
Title: Context changes everything : how constraints create coherence / Alicia Juarrero.
Description: Cambridge, Massachusetts : The MIT Press, [2023] | Includes bibliographical references and index.
Identifiers: LCCN 2022030581 (print) | LCCN 2022030582 (ebook) | ISBN 9780262545662 | ISBN 9780262374781 (epub) | ISBN 9780262374774 (pdf)
Subjects: LCSH: Complexity (Philosophy) | Causation.
Classification: LCC B105.C473 J83 2023 (print) | LCC B105.C473 (ebook) | DDC 117—dc23/eng/20230124
LC record available at https://lccn.loc.gov/2022030581
LC ebook record available at https://lccn.loc.gov/2022030582