Learning was accomplished through local experimentation and sharing of results. Success was not measured through publications, but through observed social change. It should also serve as a cautionary tale for today's researchers, however. It illustrates how effective practitioners can be at solving complex problems… once they have acquired a modest amount of knowledge relating to the design and conduct of research. It is not clear that we have trained our fellow academic researchers to be equally adept at observing, adapting to, and participating in new contexts.

Conclusion

« 19 » Undoubtedly, Umpleby's article has clarified my thinking. I also feel a certain optimism as I look towards the future. Recently, AACSB International – the best known accrediting agency for business schools – has placed a new emphasis on measuring the impact of our research on practice. We have long been aware that the academic journal article that is built around the narrowly defined scientific method is a very inefficient channel for communicating with practice. Moreover, whatever impact is achieved is nearly impossible to detect owing to the distance between the academic and practitioner communities. Achieving and detecting research impact, on the other hand, is among the greatest strengths of the endo-mode research that constitutes second-order cybernetics. Umpleby's ICA example illustrates this in a compelling way; I have seen similar impact, on a smaller scale, in my own case writing experiences. As this new top-down emphasis on impact takes hold, we will perhaps see another major rethinking of our attitudes on what makes for "good" research, paralleling the last dramatic shift, observed in the 1960s.

T. Grandon Gill is a professor in the information systems and decision sciences department of the University of South Florida, where he also serves as academic director of the Doctor of Business Administration program, which helps working executives learn to apply research methods to their business problems. His research focus is the transdisciplinary field known as informing science.

Received: 7 June 2016
Accepted: 7 June 2016

Author's Response
Struggling to Define an Identity for Second-Order Cybernetics

Stuart A. Umpleby

> Upshot • Second-order cybernetics is an important field for the scientific enterprise but it has difficulty explaining itself to those outside the field and defining itself to those inside the field.

« 1 » I shall discuss the commentaries on my target article using three themes. Two of the commentators emphasized the academic and social context of second-order cybernetics. Two commentators were concerned with how to describe the field both to people outside the field and to those inside. And two commentators were interested in the relationship of second-order cybernetics to management research and practice.

The context of second-order cybernetics

« 2 » Allenna Leonard suggests that the lack of acceptance of both first-order and second-order cybernetics is probably related to a "general lack of comprehensive social science research" (§1). By this she means a lack of interest in formulating general theories. She describes a wave of interest in general theories in the 1960s and 1970s (§2). Leonard also points to a "lower sense of common values that … now characterizes our communities and nations" (§1).

« 3 » It is certainly the case that the social sciences lack a common foundation, which the engineering disciplines find in physics and chemistry. And the number of scholars seeking to create a transdisciplinary foundational discipline for the social sciences is limited, as far as I know, to the practitioners of systems science and cybernetics – disciplines that have no established home on US campuses today. Her broader point, that there is a lack of common values in societies, may also be a contributing factor, if people do not assume that establishing a common frame of reference is possible. She is correct that corporations regularly lobby the government to forestall or diminish research that they think will reduce their profits, even if the research would benefit the public (§5). Smoking and climate change are just two examples. And participatory methods are sometimes seen by managers as threatening their prerogatives, even though their use would likely improve the performance of the organization (§4).

« 4 » I also agree with Leonard that the incentive systems in universities have in recent years moved strongly toward rewarding research in narrow disciplines rather than transdisciplinary research (§7). Government agencies frequently say that they seek interdisciplinary research proposals, but young faculty members are reluctant to work on research that will not be counted toward promotion. She suggests that the need for more use of systems and cybernetics approaches will become clearer (§9) as the unsustainability of current practices becomes more evident. In the meantime, there is plenty of work to do to develop the new points of view. Leonard's observations help to explain why research that once attracted great interest has diminished in recent decades.

« 5 » Gastón Becerra (§10) compares my article to the work of Roland García and Jean Piaget, who claimed that social, cultural, and historical contexts condition the direction that the emergence of knowledge takes. Becerra notes these authors describe two types of analysis. Psychogenesis refers to the development of knowledge from childhood to adulthood (§13). Sociogenesis describes the history of science. "Here the epistemic framework refers to a worldview resulting from philosophical, religious and ideological factors that influence the contents of theorizing by enabling or inhibiting our questions" (§10). He quotes García, according to whom…

> "a particular cultural pattern enters in a very concrete way into the shaping of science in a particular society at a particular time. It acts as an epistemological obstacle […]. Here the social component is not merely providing directionality to scientific research; it enters deeply into the conceptualization of science." (§10)

These quotations are an excellent description of the different reactions to second-or-

der cybernetics that I have witnessed in Europe and the US. In Europe, second-order cybernetics is welcomed and appreciated. In the US, in the past, it was sometimes attacked, dismissed, and disparaged as if one were denying the most fundamental tenant of a religion.

« 6 » Becerra writes that new tools and techniques are needed to integrate multidisciplinary team members (§15). Cybernetics has done this by combining a variety of methods: group facilitation methods such as those of the Institute of Cultural Affairs; causal influence diagrams; process improvement methods; and, when attempting to understand or bring about social change, the use of theories and methods from several disciplines: economics; psychology and anthropology; sociology and political science; and history and law, organized into a meta-method (Umpleby 2014: 21; Medvedeva & Umpleby 2015). I agree with Becerra that additional examples and improvement of methods are needed.

Some debates within the field

« 7 » I understand and share the frustration that Michael Lissack and others feel with the word "cybernetics." As a theory of the interaction between ideas and society, the field is unusually large in its range of interests. It essentially encompasses all human knowledge, at least in so far as knowledge is used to achieve human purposes. Currently, not many people have heard of cybernetics, even though most professionals spend several hours each day in "cyberspace." Only parts of the field are known to some academics. And current cybernetics research – in philosophy, social science, and design – is not the part that is most known. Many people in the US interpret the term as a synonym for computer science, which is more confusing than not knowing the field at all. So should we rename cybernetics? Lissack suggests a "science of context" (§19). A "science of reflexivity" would come closer to my interests. Unfortunately, no term encompasses all aspects of the field, except the name "cybernetics." The original name has the advantage of providing an address for the literature in the field.

« 8 » Although authors such as Andrew Pickering (2010) and Ronald Kline (2015) said that cybernetics ended in the mid 1970s, the American Society for Cybernetics has held an annual meeting almost every year since it was founded in 1964. Numerous journals have "cybernetics" in their titles, and a gradually increasing number of conferences on the subject are being held each year. Where the field has had difficulty has been in establishing courses and degree programs on university campuses. The institutionalization of cybernetics has been difficult primarily due to its multidisciplinary character. The field touches all the schools on a university campus, but none feel a special responsibility for it.

« 9 » It seems odd that people in business and government frequently call for more communication across disciplines, yet a field that brings together people from many disciplines and has made contributions to many disciplines is not enthusiastically established on campuses. Many books have been written applying ideas from cybernetics to numerous fields – engineering, medicine, management, arts and sciences, design, and philosophy to name a few. There is no shortage of applications. However, in each field of application, other theories and methods already exist. Specialists hesitate to learn new theories and methods when they already have a body of knowledge that is familiar and respected by others within their fields. Not everyone seeks cross-disciplinary understanding.

« 10 » Perhaps the term "cybernetics" should be used simply as an address. Rather than writing about cybernetics or second-order science, we could write about improving the efficiency and effectiveness of science and advocate more attention to how purposeful systems can better achieve their goals.

« 11 » Peter Cariani raises the question of whether cybernetics should continue to be a small revolutionary band seeking to make a scientific revolution or a broader field that welcomes interested people from many disciplines. This is a debate that has existed within the American Society for Cybernetics (ASC) since it was founded (Herr et al. 2016). I have always preferred the large-tent strategy. ASC, however, has so far decided to be a small committed band of advocates for a new development in science. What the new direction is changes somewhat with each president, but, since the 1970s, the emphasis has been on some version of second-order cybernetics.

« 12 » Cariani points out that my list of constructivist philosophers is incomplete. I appreciate the additional references. He suggests that second-order cybernetics may not be the best banner under which to advance this alternative understanding of science. Perhaps broadening the group involved in the discussion would lead to a new name for the field.

« 13 » Cariani provides a succinct but thorough explanation of how practicing scientists, particularly in biology, operate, knowing that the role of the observer is essential. The debate within cybernetics has usually been between engineers and scientists/ philosophers. I agree with Cariani that many second-order ideas were present in the earliest writings on cybernetics. But as the field developed, the engineering applications – computers, artificial intelligence, and robotics – received the most attention. The term "second-order cybernetics" was chosen in an attempt to refocus attention on the early interest of Warren McCulloch, Heinz von Foerster, and others in cognition. I agree that there is no need to divide cybernetics, but most people outside the field assume that cybernetics means computers, so some modifier of "cybernetics" has been helpful.

« 14 » Regarding Cariani's comments (§12) on the loss of funding for cybernetics in the 1970s, in conversations that I heard, the subjective approach of cybernetics was considered to be naïve, out-dated, and not worthy of support. This was the view of people both at the University of Illinois and in the Research Applied to National Needs program in the National Science Foundation. The two epistemologies – realism and constructivism – continue to be discussed in the US in two societies, one devoted to systems science and one to cybernetics. There have been efforts over the years to combine the two societies, in part to minimize administrative work. These efforts have failed because of the sharp difference of opinion regarding acceptable epistemologies. In Europe and elsewhere, systems and cybernetics topics can be discussed in one conference, but not yet in the US.

Implications for applications

« 15 » Thomas Flanagan emphasizes the need for second-order cybernetics to be connected to practice through methods. He mentions in particular structured dialogic design (SSD), system dynamics modeling, and interpretive structural modeling. I agree that repeated testing is the way to improve and extend a scientific theory. However, I think of second-order cybernetics as being different from the usual theory. Whereas we usually critique scientific practice from the perspective of philosophy of science, cybernetics, because it is based on neurobiology, provides a way to critique present conceptions of knowledge and science. As our conception of knowledge changes, new ways of doing science are considered appropriate.

« 16 » Cybernetics originated in a desire to create a science of the informational domain (i.e., communication and control) in addition to the physical domain (i.e., matter and energy). Since the philosophy of science usually illustrates its examples of how science should be done by citing examples from physics, social researchers, in an effort to create social science, have sought to imitate physics and overlooked cybernetics. The result is a preoccupation in contemporary social science with finding linear causal relations with a high level of statistical significance, often independent of a theory. Meanwhile, schools of management have constructed knowledge in narrow fields – finance, marketing, accounting, and labor relations – without regard to a general theory. And research in universities is evaluated by number of publications in peer reviewed journals, rather than its utility in improving the performance of individuals and organizations. The result is that the literature on management and social science often lacks clear connections to philosophy, theory, and practice.

« 17 » Second-order cybernetics began with an effort by von Foerster to include the observer in the descriptions created by scientists. This suggestion was resisted, often quite strongly, by those who felt that including the observer would imply self-reference and lead to paradox and inconsistency. Maintaining that the observer could be excluded from research descriptions enabled scientists to claim objectivity and lack of bias. Von Foerster (1971) cited the work of John von Neumann, Gotthard Günther und Lars Löfgren that concluded that self-referential statements do not necessarily lead to inconsistencies, but the desire to avoid political controversy led scientists to adopt the claim that they were doing objective research. My concern is that our current conception of science, that descriptions can somehow be created without observers, is limiting our ability to describe important problems and therefore to devise needed solutions. When people hold different views, creating multiple descriptions is necessary.

« 18 » I believe that cybernetics, as a general theory of communication and control, a general theory of management, and a general theory of an information society, will progress most successfully if it clearly states its connection to philosophy, theory, and practice. So far, second-order cybernetics has tended to emphasize the biology of cognition, i.e., it focused on the individual knower. By connecting second-order cybernetics to the large literature on management methods, particularly group methods, second-order cybernetics can make clear its practical utility and its status as a general theory of management, namely that human groups work more effectively when they use explicit methods for engaging in problem-solving tasks.

« 19 » Some of the best work in management is done by consultants who work most closely with clients and who are not constrained by narrowing what they observe to the issues of interest in an academic field.

« 20 » The Institute of Cultural Affairs (ICA) did not know about second-order cybernetics in the 1950s or even until recent years (§5). The term "second-order cybernetics" was invented in the 1970s. However, the ICA did know about – and disagreed with – Saul Alinsky's approach to community organizing in Chicago (Alinsky 1971), and they had read the work of systems theorists such as Kenneth Boulding and Margaret Mead. My point in the target article was that the work of ICA, both at the local level and in designing and carrying out a global strategy, was compatible with and could be thought of as an illustration of principles from second-order cybernetics.

« 21 » My purpose in describing the work of ICA was to illustrate both a different way of doing research on organizations and a different goal for doing research (§6). Second-order cybernetics originally focused on the role of the observer in doing scientific research and, by extension, the importance of the points of view of different participants in an experiment. Much social science research today focuses on surveying respondents and analyzing data. Facilitating conversations among a group of people who share an interest in an organization is done not to establish a causal relationship among variables but rather to improve the operation of a social system. Facilitated group discussions are a kind of research in that the participants learn what the members of the group are thinking. Decisions are made, acted upon, and after a few months the planning process is repeated. It is an iterative approach – small steps eventually leading to large changes.

« 22 » People at the local level are learning what the group feels is needed and what actions they think will be fruitful. The facilitators are learning what methods seem to work best and what kinds of problems arise in more than one community. Hence, they can be better prepared when those issues arise in the future. Discussions at the local level also serve as training programs for the participants. After participating in several meetings, a person can move up to leading a small group discussion and later a plenary session. Training sessions for group leaders are also conducted in addition to the planning and organizing meetings. With additional experience, participants are able to lead training programs and later suggest different methods and training programs.

« 23 » Many people in management do not think of management methods as the result of research. The methods are just "how we do things." It is a mistake to think that only academics do research. Process improvement methods constitute a kind of research as well (Umpleby 2002). They are also a way of designing and redesigning an organization.

« 24 » I think of second-order cybernetics not so much as a way of interacting with clients or of developing methods for facilitating group discussions but rather as an argument for why working with people in groups on problems of interest to them is a legitimate form of scientific research (§16).

The purpose of science must not only be to publish research results in journals but also to help people achieve their goals by working in harmony with their colleagues and neighbors.

« 25 » Developing management methods (i.e., procedures used in organizations) is often considered to be different from management research, which is thought to involve analyzing data (§17). But individuals and organizations are purposeful systems. Cybernetics is a science of purposeful systems. Developing methods that improve the performance of individuals or organizations is definitely a form of scientific research that should be guided by second order cybernetics. As Flanagan's Figure 1, citing Warfield, illustrates, it is empirical and guided by theory.

« 26 » Grandon Gill places my article in the context of two approaches to business research: the case method and classical social science research. He notes that my arguments would support the legitimacy and appropriateness of the case approach relative to social science research (§§2f).

« 27 » I like this framing of the issues. However, I believe there is a third approach. Service-learning has been increasing steadily as a teaching method in recent decades (Umpleby 2011). In service-learning, students work with clients on current problems, rather than examples from a textbook. I have my students do service-learning projects with organizations – a business, a government agency, or a non-governmental organization. I describe the projects as the laboratory part of the course, see http://www.gwu.edu/~rpsol/service-learning. In their project reports, students are expected to describe their activities using as many concepts from the course as possible. In this way, the concepts in the course are connected to their personal experiences and observations.

« 28 » The theory that underlies a cybernetics approach to research is that both individuals and organizations are purposeful systems. The goals of such systems, and how the goals change, is an essential part of understanding and modifying them. Note that the classical approach to science places the observer outside the system being studied. Although this assumption has worked well in the natural sciences, carrying it over to management research conflicts with the phenomenon being studied. Managers are members of the organizations they manage and how the two interact is the subject being investigated. Gill notes that not only managers but also the writer of a discussion case study interact frequently with the manager and organization and generally adopt the point of view of the decision-maker (§9).

« 29 » Gill wisely and accurately notes that greater involvement by researchers in the organizations they study will require new skills in working within very different cultures (§18). And he expresses his hope that the new emphasis on measuring the impact of research will lead to rethinking our attitudes on what makes for good research (§19).

Conclusion

« 30 » The field of cybernetics, by creating a general theory of communication and control, is a major contribution to contemporary science. It provides a common foundation for the biological and social sciences by pointing out the similarity of circular causal and feedback processes. Reflexive processes, where elements of a social system both observe and participate, have been an important recent addition (Lefebvre 1982, 2006; Soros 1987, 2014). Second-order cybernetics, since the term was introduced in the mid 1970s, has enabled cybernetics to continue to make noteworthy contributions. Work on second-order cybernetics in the past 40 years has led those in the field to believe that it enables a reconceptualization of the scientific enterprise, one that will accelerate the contributions that scientists can make to improving our ability to cope with current and future events.

« 31 » There are many challenges to guide future research. But the primary challenge seems to be explaining cybernetics and second-order cybernetics to the scientific community and to university faculty and administrators. The difficulty of this task provides evidence that cybernetics is a different kind of academic field.

Received: 27 June 2016
Accepted: 28 June 2016

Combined References

Ackoff R. L. & Emery F. E. (1972) On purposeful systems. Aldine-Atherton, Chicago.

Alinsky S. D. (1971) Rules for radicals: A practical primer for realistic radicals. Random House, New York.

Alrøe H. F. & Noe E. (2014) Second-order science of interdisciplinary research: A polyocular framework for wicked problems. Constructivist Foundations 10(1): 65–76. ▸ http://constructivist.info/10/1/065

Argyris C. & Schön D. A. (1974) Theory in practice. Increasing professional effectiveness. Jossey-Bass, San Francisco CA.

Ashby W. R. (1952) Design for a brain: The origin of adaptive behaviour. Chapman and Hall, London.

Ashby W. R. (1958) Requisite variety and its implications for the control of complex systems. Cybernetica 1(2): 83–99.

Baecker D. (2013) Beobachter unter sich. Eine Kulturtheorie. Suhrkamp, Frankfurt.

Bateson G. (1972) Steps to an ecology of mind: Collected essays in anthropology, psychiatry, evolution, and epistemology. Chandler Publishing, San Francisco.

Bausch K. & Christakis A. N. (eds.) (2015) With reason and vision: Structured dialogic design. Ongoing Emergence Press, Cincinnati OH.

Bausch K. C. & Flanagan T. R. (2013) A confluence of third-phase science and dialogic design. Systems Research and Behavioral Science 30(4): 414–429.

Becerra G. & Amozurrutia J. A. (2015) Rolando García's "Complex Systems Theory" and its relevance to sociocybernetics. Journal of Sociocybernetics, 13(1), 18–30.

Becerra G. & Castorina J. A. (2015) El condicionamiento del "marco epistémico" en distintos tipos de análisis constructivista [The epistemic framework and the different levels of constructivist analysis]. In: Ahumada J. V., Venturelli A. N. & Chibeni S. S. (eds.) Filosofía e historia de la ciencia en el Cono Sur. Universidad Nacional de Córdoba, Córdoba: 101–107.

Beer S. (1994) Beyond dispute: The invention of team syntegrity. Wiley, Chichester.

Boden M. A. (2006) Mind as machine: A history of cognitive science. Oxford University Press, Oxford.

Boix-mansilla V. (2006) Interdisciplinary work at the frontier: An empirical examination

of expert interdisciplinary epistemologies. Issues in Integrative Studies 31(24): 1–31.

Brün H. (2004) When music resists meaning: The major writings of Herbert Brün. Edited by Arun Chandra. Wesleyan University Press, Middletown CT.

Burbidge J. (ed.) (1988) Approaches that work in rural development: Emerging trends, participatory methods and local initiatives. K. G. Saur, New York.

Burman J. T. (2007) Piaget no "remedy" for Kuhn, but the two should be read together: Comment on Tsou's 'Piaget vs. Kuhn on Scientific Progress.' Theory & Psychology 17(5): 721–732. ▸ http://cepa.info/2835

Cariani P. (1993) To evolve an ear: Epistemological implications of Gordon Pask's electrochemical devices. Systems Research 10 (3): 19–33. ▸ http://cepa.info/2836

Cariani P. (2009) The homeostat as embodiment of adaptive control. International Journal of General Systems, 38(2): 139–154. ▸ http://cepa.info/349

Charter N. & Loewenstein G. (2016) The underappreciated drive for sense-making. Journal of Economic Behavior & Organization 126B: 137–154.

Christakis A. & Bausch K. C. (2006) Co-laboratories of democracy: How people harness their collective wisdom to create the future. Information Age Publishing, Boston MA.

Clarke B. (2014) Neocybernetics and narrative. University of Minnesota Press, Minneapolis MN.

Cooperrider D. L. & Whitney D. (2005) Appreciative inquiry: A positive revolution in change. Berrett-Koehler, San Francisco CA.

Corona E. & Thomas B. (2010) A new perspective on the early history of the American Society for Cybernetics. Journal of the Washington Academy of Sciences. Summer 2010: 21–34.

de Latil P. (1956) Thinking by machine. Houghton Mifflin, Boston.

Derman E. (2011) Models. Behaving. Badly: Why confusing illusion with reality can lead to disaster, on Wall Street and in life. Free Press, New York.

Dreyfus H. L. & Dreyfus S. E. (1988) Making a mind versus modeling the brain: Artificial intelligence at a branchpoint. Daedalus 117(1): 15–43.

Fals Borda O. (1978) Über das Problem, wie man die Realität erforscht, um sie zu verändern. In: Moser H. & Ornauer H. (eds.) Internationale Aspekte der Aktionsforschung. Kösel, Munich: 78–112.

Flanagan T. R. (2008) Scripting a collaborative narrative: An approach for spanning boundaries. Design Management Review 19(3): 80–86.

Flanagan T. R. (2014) Designing the means for governing the commons. In: Metcalf G. S. (ed.) Social systems and design. Springer, Tokyo: 147–166.

Foerster H. von (1948) Das Gedächtnis. Eine quantenphysikalische Untersuchung. Franz Deuticke, Vienna.

Foerster H. von (1960) On self-organizing systems and their environments. In: Yovits M. C. & Cameron S. (eds.) Self-Organizing Systems. Pergamon Press, London: 31–50. Reprinted in: Foerster H. von (2003) Understanding understanding: Essays on cybernetics and cognition. Springer, New York: 1–19. ▸ http://cepa.info/1593

Foerster H. von (1971) Computing in the semantic domain. Annals of the New York Academy of Sciences 184: 239–241. ▸ http://cepa.info/1645

Foerster H. von (ed.) (1974) Cybernetics of cybernetics. Future Systems, Minneapolis MN.

Foerster H. von (1981) Formalización de ciertos aspectos de las estructuras cognitivas. In: Inhelder B., García R. & Voneche J. (eds.) Jean Piaget. Epistemología genética y equilibración. Fundamentos, Madrid: 89–105. Originally published as: Foerster H. von (1976) Objects: Tokens for (eigen-) behaviours. ASC Cybernetics Forum 8(3–4): 91–96. Republished in: Foerster H. von (2003) Understanding understanding: Essays on cybernetics and cognition. Springer, New York: 261–271.

Foerster H. von (1988) Abbau und Aufbau. In: Simon F. B. (ed.) Lebende Systeme: Wirklichkeitskonstruktionen in der Systemischen Therapie. Springer Verlag, Heidelberg: 19–33.

Foerster H. von (2003a) Cybernetics of cybernetics. In: Foerster H. von, Understanding understanding. Springer, New York: 283–286. Originally published in 1979. ▸ http://cepa.info/1707

Foerster H. von (2003b) Cybernetics of epistemology. In: Foerster H. von, Understanding understanding. Springer, New York: 229–246. Originally published in 1974.

Foerster H. von (2003c) Ethics and second-order cybernetics. In: Foerster H. von, Understanding understanding. Springer, New York: 287–304. Originally published in 1992. ▸ http://cepa.info/1742

Foerster H. von (2003d) On constructing a reality. In: Foerster H. von, Understanding understanding: Essays on cybernetics and cognition. Springer, New York: 211–228. Originally published in: Preiser F. E. (ed.) (1973) Environmental design research. Volume 2. Dowdon, Hutchinson & Ross, Stroudberg: 35–46. ▸ http://cepa.info/1278

Foerster H. von (2003e) What is memory that it may have hindsight and foresight as well? In: Foerster H. von, Understanding understanding. Springer, New York: 101–131. Originally published in: Bogoch S. (ed.) (1969) The future of the brain sciences. Proceedings of a conference held at the New York Academy of Medicine. Plenum Press, New York: 19–64.

Foerster H. von (2014) The beginning of heaven and earth has no name. 7 days with second-order cybernetics. Fordham University Press, New York.

Foerster H. von, Mora P. M. & Amiot L. W. (1960) Doomsday: Friday, 13 November A. D. 2026. Science 132: 1291–1295. ▸ http://cepa.info/1596

Foerster H. von & Müller K. H. (2003) Action without utility. An immodest proposal for the cognitive foundation of behavior. Cybernetics & Human Knowing 10(3–4): 27– 50. ▸ http://cepa.info/2700

García R. (1987) Sociology of science and sociogenesis of knowledge. In: Inhelder B., Caprona D. & Cornu A. (eds.) Piaget today. Taylor & Francis, New York: 127–140.

García R. (1992) The structure of knowledge and the knowledge of structure. In: Beilin H. & Bufall P. (eds.) Piaget's theory: Prospects and possibilities. Routledge, Chicago: 21–38.

García R. (1997) La epistemología genética y la ciencia contemporánea: Homenaje a Jean Piaget en su centenario [Genetic epistemology and contemporary science: Homage to Jean Piaget and his followers]. Gedisa, Barcelona.

García R. (1999) A systemic interpretation of Piaget's theory of knowledge. In: Scholnick E. K., Nelson C., Gerlman S. & Miller P. (eds.) Conceptual development: Piaget's legacy. LEA, Mahwah NJ: 165–184. ▸ http://cepa.info/2782

García R. (2000) El conocimiento en construcción: De las formulaciones de Jean Piaget a la teoría de sistemas complejos [Knowledge

in construction: From Jean Piaget's writings to the theory of complex systems]. Gedisa, Barcelona.

García R. (2006) Sistemas complejos. Conceptos, método y fundamentación epistemológica de la investigación interdisciplinaria [Complex systems: Concepts, methods and epistemology of interdisciplinary research]. Gedisa, Barcelona.

Gibbons M., Limoges C., Nowotny H., Schwartzman S., Scott P. & Trow M. (1994) The new production of knowledge: The dynamics of science and research in contemporary societies. Sage Publications, London.

Gill T. G. (2010) Informing business: Research and education on a rugged landscape. Informing Science Press, Santa Rosa CA.

Gill T. G. (2011) Informing with the case method. Informing Science Press, Santa Rosa CA.

Gill T. G. (2012) Informing on a rugged landscape: Homophily versus expertise. Informing Science: The International Journal of an Emerging Transdiscipline 15: 49–91.

Glanville R. (1982) Inside every white box there are two black boxes trying to get out. Behavioral Science 27(1): 1–11. ▸ http://cepa.info/2365

Glasersfeld E. von (1995) Radical constructivism: A way of knowing and learning. Falmer Press, London.

Glasersfeld E. von (2001) The radical constructivist view of science. Foundations of Science 6(1–3): 31–43. ▸ http://cepa.info/1536

Glasersfeld E. von (2005) Radikaler Konstruktivismus – Versuch einer Wissenstheorie. Edited by Albert Müller and Karl H. Müller. Edition echoraum, Vienna.

Glasersfeld E. von (2007) Key works in radical constructivism. Edited by Marie Larochelle. Sense, Rotterdam.

Glasersfeld E. von (2008) Who conceives of society? Constructivist Foundations 3(2): 59–64. ▸ http://constructivist.info/3/2/059

Goldman A. & Blanchard T. (2015) Social epistemology. In: Zalta E. N. (ed.) The Stanford encyclopedia of philosophy (Summer 2015 Edition). http://plato.stanford.edu/archives/sum2015/entries/epistemology-social

Gould S. (2010) Triumph and tragedy in Mudville: A Lifelong passion for baseball. W. W. Norton, New York.

Greenwood D. J. & Levin M. (2007) Introduction to action research. Second edition. Sage Publications, Thousand Oaks CA.

Haraway D. J. (1988) Situated knowledges: The science question in feminism and the privilege of partial perspective. Feminist Studies 14: 575–599.

Haraway D. J. (1991) Simians, cyborgs, and women: The reinvention of nature. The Free Association Books, London.

Hawking S. & Mlodinow L. (2010) The grand design. Bantam Books, New York.

Held R. & Hein A. (1963) Movement-produced stimulation in the development of visually guided behaviour. Journal of Comparative and Physiological Psychology 56(5): 872–876.

Herr C. M., Fischer T., Glanville R. & Guddemi P. (eds.) (2016) 50th anniversary retrospective of the ASC. Special Issue. Cybernetics & Human Knowing 23(1).

Hollingsworth J. R. & Müller K. H. (2008) Transforming socio-economics with a new epistemology. Socio-Economic Review 3(6): 395–426.

Inhelder B., García R. & Voneche J. (1981) Jean Piaget. Epistemología genética y equilibración. Fundamentos, Madrid. Originally published in French as: Inhelder B., García R. & Voneche J. (1977) Epistémologie génétique et équilibration [Genetic epistemology and equilibration]. Delachaux & Niestlé, Neuchatel.

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

Kahneman D. (2011) Thinking, fast and slow. Farrar, Straus, and Giroux, New York.

Kandel E. R. (2012) The age of insight. The quest to understand the unconscious in art, mind, and brain, from Vienna 1900 to the present. Random House, New York.

Kelly G. (1955) The psychology of personal constructs. 2 Volumes. Norton, New York.

Kline R. R. (2015) The cybernetics moment or why we call our age the information age. The Johns Hopkins University Press, Baltimore.

Knorr-Cetina K. (1989) Spielarten des Konstruktivismus: Einige Notizen und Anmerkungen [Varieties of constructivism: Some notes and comments]. Soziale Welt 40(1/2): 86–96. ▸ http://cepa.info/2776

Krippendorff K. & Clemson B. (2016) A merger of two strategic (ir)/reconcilables, 1962–1980. Cybernetics & Human Knowing 23(1): 10–18.

Kuhn T. S. (1962) The structure of scientific revolutions. University of Chicago Press, Chicago.

Kuhn T. S. (1970) The structure of scientific revolutions. Second edition. University of Chicago Press, Chicago.

Lakoff G. (2012) Explaining embodied cognition results. Topics in Cognitive Science 4: 773–785.

Lefebvre V. (1982) Algebra of conscience: A comparative analysis of Western and Soviet ethical systems. D. Reidel, Boston MA.

Lefebvre V. (2001) Algebra of conscience. Revised edition with a second part and a new foreword by Anatol Rapoport. Kluwer, Dordrecht.

Lefebvre V. (2006) Research on bipolarity and reflexivity. With a postscript by Karl Popper. Edwin Mellen Press, Lewiston NY.

Lissack M. (2016) Don't be addicted: The oft overlooked dangers of simplification. She Ji: The Journal of Design, Economics, and Innovation. In press.

Lissack M. & Graber A. (eds.) (2014) Modes of explanation: Affordances for action and prediction. Palgrave Macmillan, Basingstoke UK.

Luhmann N. (1990) The cognitive program of constructivism and a reality that remains unknown. In: Krohn W., Küppers G. & Nowotny H. (eds.) Selforganization: Portrait of a scientific revolution. Springer, Dordrecht: 64–86. ▸ http://cepa.info/2712

Luhmann N. (1997) Die Gesellschaft der Gesellschaft. 2 volumes. Suhrkamp, Frankfurt.

Lupton D. (2013) Risk. Second edition. Routledge, London.

Maturana H. R. (1975) The organization of the living: A theory of the living organization. International Journal of Man-Machine Studies 7(3): 313–332. ▸ http://cepa.info/547

Maturana H. R. (1978) Biology of language: The epistemology of reality. In: Miller G. & Lenneberg E. (eds.) Psychology and biology of language and thought: Essays in honor of Eric Lenneberg. Academic Press, New York: 27–63. ▸ http://cepa.info/549

Maturana H. R. & Varela F. J. (1980) Autopoiesis and cognition: The realization of the living. Kluwer, Dordrecht.

Maturana H. R. & Varela F. J. (1992) The tree of knowledge: The biological roots of human understanding. Revised Edition. Shambhala, Boston.

McCulloch W. (1965) Embodiments of mind. MIT Press, Cambridge MA.

Medvedeva T. A. & Umpleby S. A. (2015) A multi-disciplinary view of social and labor

relations: Changes in management in the U. S. and Russia as examples. Cybernetics and Systems 46(8): 681–697.

Miles R. E. Jr. (1978) The origin and meaning of Miles' Law. Public Administration Review 38(5): 399–403.

Munévar G. (1981) Radical epistemology. Hackett, Indianapolis.

Murdoch D. (1987) Niels Bohr's philosophy of physics. Cambridge University Press, Cambridge.

Müller K. H. (2008) Methodologizing radical constructivism: Recipes for RC-Designs in the social sciences. Constructivist Foundations 4(1): 50–61. ▸ http://constructivist.info/4/1/050

Müller K. H. (2010) The radical constructivist movement and its network formations. Constructivist Foundations 6(1): 31–39. ▸ http://constructivist.info/6/1/031

Müller K. H. (2011) The two epistemologies of Ernst von Glasersfeld. Constructivist Foundations 6(2): 220–226. ▸ http://constructivist.info/6/2/220

Müller K. H. (2015) De profundis. Ranulph Glanville's transcendental framework for second-order cybernetics. Cybernetics & Human Knowing 22(2–3): 27–47. ▸ http://cepa.info/2699

Müller K. H. (2016) Second-order science. The revolution of scientific structures. Edition echoraum, Vienna. ▸ http://cepa.info/1148

Nowotny H., Scott P. & Gibbons M. (2001) Re-thinking science. Knowledge and the public in an age of uncertainty. Polity Press, Cambridge.

Ostrom E. (1990) Governing the commons: The evolution of institutions for collective action. Cambridge University Press, Cambridge UK.

Overton W. F. (1994) Contexts of meaning: The computational and the embodied mind. In: Overton W. F. & Palermo D. S. (eds.) The nature and ontogenesis of meaning. LEA, Hillsdale NJ: 1–18.

Pask G. (1975a) Conversation, cognition and learning. Elsevier, Amsterdam.

Pask G. (1975b) The cybernetics of human learning and performance. Hutchinson, London.

Piaget J. (1970) Genetic epistemology. The Norton Library, New York.

Piaget J. & García R. (1982) Psicogénesis e historia de la ciencia. Siglo XXI, México. English translation: Piaget J. & García R. (1989) Psychogenesis and the history of science. Columbia University Press, New York.

Piaget J. & García R. (1988) Hacia una lógica de significaciones. Centro editor de América Latina, Buenos Aires. Originally published in French as: Piaget J. & García R. (1987) Vers une logique des significations [Towards a logic of significations]. Murionde, Geneva.

Pias C. (2003) Cybernetics: The Macy conferences 1946–1953. Diaphanes, Zurich.

Piattelli-Palmarini M. (1996) Inevitable illusions: How mistakes of reason rule our minds. Wiley, New York.

Pickering A. (2010) The cybernetic brain: Sketches of another future. University of Chicago Press, Chicago.

Reason P. & Bradbury H. (eds.) (2001) The SAGE handbook of action research. Participative inquiry and practice. Sage, London.

Reichardt J. (ed.) (1968) Cybernetic serendipity: The computer and the arts. Praeger, New York.

Rorty R. (1991) Objectivity, relativism, and truth: Philosophical papers. Volume 1. Cambridge University Press, Cambridge.

Rosen R. (1985) Anticipatory systems: Philosophical, mathematical, and methodological foundations. Pergamon Press, Oxford.

Rysiew P. (2016) Epistemic contextualism. In: Zalta E. N. (ed.) The Stanford encyclopedia of philosophy (Summer 2016 Edition). http://plato.stanford.edu/entries/contextualism-epistemology/

Saris W. E. & Gallhofer I. N. (2007) Design, evaluation, and analysis of questionnaires for survey research. Wiley Interscience, Hoboken NJ.

Soros G. (1987) The alchemy of finance: Reading the mind of the market. Simon and Schuster, New York.

Soros G. (2014) Fallibility, reflexivity, and the human uncertainty principle. Journal of Economic Methodology 20(4): 309–329.

Steffe L. P. (2007) Radical constructivism: A scientific research program. Constructivist Foundations 2(2–3): 41–49. ▸ http://constructivist.info/2/2-3/041

Suri R. (2008) Growth at the bottom. Delinking poverty-combat from "development." A non-charity solution to global poverty in a short time. WISDOM RISC-Papers, Vienna.

Umpleby S. A. (1974) On making a scientific revolution. In: Foerster H. von (ed.) Cybernetics of cybernetics or the control of control and the communication of communication. The Biological Computer Laboratory, Urbana IL: 130–131. ▸ http://cepa.info/2410

Umpleby S. A. (1979) Computer conference on general systems theory: One year's experience. In: Henderson M. M. & MacNaughton M. J. (eds.) Electronic communication: Technology and impacts. Westview Press, Boulder CO: 55–63.

Umpleby S. A. (1987) American and Soviet discussions of the foundations of cybernetics and general system theory. Cybernetics and Systems 18: 177–193.

Umpleby S. A. (1997) Cybernetics of conceptual systems. Cybernetics and Systems 28(8): 635–652. ▸ http://cepa.info/1854

Umpleby S. A. (2002) Should knowledge of management be organized as theories or as methods? Janus Head 5(1): 181–195. ▸ http://cepa.info/1884

Umpleby S. A. (2003) Heinz von Foerster and the Mansfield Amendment. Cybernetics & Human Knowing 10(3–4): 161–163. ▸ http://cepa.info/1876

Umpleby S. A. (2011) Service-learning as a method of instruction. Journal of the Washington Academy of Sciences 97(4): 1–15.

Umpleby S. A. (2014) Second-order science: Logic, strategies, methods. Constructivist Foundations 10(1): 16–23. ▸ http://constructivist.info/10/1/016

Umpleby S. A. (2016) Reviving the American Society for Cybernetics. Cybernetics & Human Knowing 23(1): 19–27. ▸ http://cepa.info/2837

Umpleby S. A. & Oyler A. (2007) A global strategy for human development: The work of the institute of cultural affairs. Systems Research and Behavioral Science 24: 645–653.

Umpleby S. A. & Thomas K. S. (1983) Applying systems theory to the conduct of systems research. In: Debons A. (ed.) Information science in action: System design. Volume 1. Martinus Nijhoff, The Hague: 381–395.

Vaihinger H. (1924) The philosophy of "as if": A system of the theoretical, practical and religious fictions of mankind. Translated by C. K. Ogden. Routledge, and Kegan Paul, London. German original published in 1911.

Van Fraassen B. C. (1980) The scientific image. Oxford University Press, Oxford.

Varela F. J. & Shear J. (eds.) (1999) The view from within: First-person approaches to the study of consciousness. Imprint Academic, Thorverton.

Varela F. & Singer W. (1987) Neuronal dynamics in the visual cortico-thalamic pathway as revealed through binocular rivalry. Experimental Brain Research 66(1): 10–20.

Vörös S., Froese T. & Riegler A. (2016) Epistemological odyssey: Introduction to special issue on the diversity of enactivism and neurophenomenology. Constructivist Foundations 11(2): 189–203. ▸ http://constructivist.info/11/2/189

Warfield J. N. (1986) The domain of science model: Evolution and design. In: Proceedings of the 30th annual meeting of the Society for General Systems Research. Intersystems, Salinas CA: H46-H59.

Warfield J. N. (1987) The domain of science model: Extensions and restrictions. George Mason University white paper, John N. Warfield Collection 35.14. http://hdl.handle.net/1920/3303

Warfield J. N. & Cardenas A. R. (1994) A handbook of interactive management. Iowa State University Press: Ames.

Weick K. (1995) Sensemaking in organizations. Sage, Thousand Oaks CA.

Wiener N. (1948) Cybernetics, or control and communication in the animal and the machine. MIT Press, Cambridge MA.

Wiener N. (1950) The human use of human beings. Houghton Mifflin, Boston MA.

Wittgenstein L. (1967) Philosophical investigations. Translated by G. E. M. Anscombe. Third edition. Basil Blackwell, Oxford. Originally published in 1953.

Yin R. K. (2009) Case study research: Design and methods. 4th edition. Sage, Thousand Oaks CA.