

Key Publications by Topic (out of over 400)

Discovery of Nonequilibrium Phase Transitions (Self-Organization) in Biological Coordination

Kelso, J.A.S. (1984). Phase transitions and critical behavior in human bimanual coordination. *American Journal of Physiology: Regulatory, Integrative and Comparative*, 15, R1000-R1004.

Kelso, J.A.S., & Scholz, J.P. (1985). Cooperative phenomena in biological motion. In H. Haken (Ed.), *Complex Systems: Operational approaches in neurobiology, physics and computers*. Springer-Verlag: Berlin.

Kelso, J.A.S., Scholz, J.P. & Schöner, G. (1986). Nonequilibrium phase transitions in coordinated biological motion: Critical fluctuations. *Physics Letters A*, 118, 279-284.

Kelso, J.A.S., Schöner, G., Scholz, J.P., & Haken, H. (1987). Nonequilibrium phase transitions in coordinated movements involving many degrees of freedom. *Annals of the New York Academy of Science*, 504, 293-296.

Kelso, J.A.S., Schöner, G., Scholz, J.P. & Haken, H. (1987). Phase-locked modes, phase transitions and component oscillators in coordinated biological motion, *Physica Scripta*, 35, 79-87.

Kelso, J.A.S. (2010). Instabilities and phase transitions in human brain and behavior. *Frontiers in Human Neuroscience* 4:23. doi:10.3389/fnhum.2010.00023

Scholz, J.P., Kelso, J.A.S. & Schöner, G. (1987). Nonequilibrium phase transitions in coordinated biological motion: Critical slowing down and switching time. *Physics Letters A*, 8, 390-394.

Scholz, J.P. & Kelso, J.A.S. (1989) A quantitative approach to understanding the formation and change of coordinated movement patterns. *Journal of Motor Behavior*, 21, 122-144.

Schöner, G. & Kelso, J.A.S. (1988) Dynamic pattern generation in behavioral and neural systems. *Science*, 239, 1513-1520.

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Kelso, J.A.S. (2017) Applying oneself to Synergetics. In Kriz, J. & Tschacher, W. (Eds) *Synergetik als Ordner*, Pabst Science Publishers, Lengerich, pp. 33-39.

Theoretical Modeling of Biological Coordination

Haken, H., Kelso, J.A.S., & Bunz, H. (1985). A theoretical model of phase transitions in human hand movements. *Biological Cybernetics*, 51, 347-356.

Schöner, G., Haken, H., & Kelso, J.A.S. (1986). A stochastic theory of phase transitions in human hand movement. *Biological Cybernetics*, 53, 247-257.

Kelso, J.A.S., DelColle, J. & Schöner, G. (1990). Action-Perception as a pattern formation process. In M. Jeannerod (Ed.), *Attention and Performance XIII*, Hillsdale, NJ: Erlbaum, pp. 139-169.

Eisenhammer, T., Hubler, A., Packard, N. & Kelso, J.A.S. (1991). Modeling experimental time series with ordinary differential equations. *Biological Cybernetics*, 65, 107-112.

Fuchs, A. & Kelso, J.A.S. (1994). A theoretical note on models of interlimb coordination. *Journal of Experimental Psychology: Human Perception and Performance*, 20/5, 1088-1097.

Fuchs, A., Jirsa, V. K., Haken, H., & Kelso, J. A. S. (1996). Extending the HKB-Model of coordinated movement to oscillators with different eigenfrequencies. *Biological Cybernetics* 74, 21-30.

Schöner, G. & Kelso, J.A.S. (1988). A synergetic theory of environmentally-specified and learned patterns of movement coordination. I. Relative phase dynamics. *Biological Cybernetics* 58, 71-80. II. Component oscillator dynamics. *Biological Cybernetics*, 58, 81-89.

Kelso, J.A.S. & Fuchs, A. (2016). The coordination dynamics of mobile conjugate reinforcement. *Biological Cybernetics*, 110 (1), 41-53. DOI 10.1007/s00422-015-0676-0

Zhang, M., Beetle, C., Kelso, J.A.S., & Tognoli, E. (under review). Connecting empirical phenomena and theoretical models of biological coordination across scales.

Discovery of Nonequilibrium Phase Transitions (Self-Organization) in the Human Brain

Kelso, J.A.S., Bressler, S.L., Buchanan, S., DeGuzman, G.C., Ding, M., Fuchs, A. & Holroyd, T. (1991). Cooperative and critical phenomena in the human brain revealed by multiple SQUIDS. In D. Duke & W. Pritchard, (Eds.), *Measuring Chaos in the Human Brain*, 97-112. World Scientific, New Jersey.

Kelso, J.A.S., Bressler, S.L., Buchanan, S., DeGuzman, G.C., Ding, M., Fuchs, A. & Holroyd, T. (1992). A phase transition in human brain and behavior. *Physics Letters A*, 169, 134-144.

Fuchs, A., Kelso, J.A.S. & Haken, H. (1992). Phase transitions in the human brain: Spatial mode dynamics. *International Journal of Bifurcation and Chaos*, 2, 917-939.

Mayville, J.M., Bressler, S.L., Fuchs, A., & Kelso, J.A.S. (1999). Spatiotemporal reorganization of electrical activity in the human brain associated with a phase transition in rhythmic auditory-motor coordination. *Experimental Brain Research*, 127, 371-381.

Wallenstein, G.V., Kelso, J.A.S. & Bressler, S.L. (1995). Phase transitions in spatiotemporal patterns of brain activity and behavior. *Physica D*, 84, 626-634.

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Fuchs, A. Mayville, J., Cheyne, D., Weinberg, H., Deecke, L., & Kelso, J.A.S. (2000) Spatiotemporal analysis of neuromagnetic events underlying the emergence of coordinative instabilities. *NeuroImage*, 12, 71-84.

Banerjee, A., Tognoli, E., Kelso, J.A.S., & Jirsa, V.K. (2012) Spatiotemporal reorganization of large-scale neural assemblies mediates bimanual coordination. *NeuroImage* doi.org/10.1016/j.neuroimage.2012.05.046

Theoretical Modeling of Brain & Behavioral Coordination

Kelso, J.A.S., Dumas, G., & Tognoli, E. (2013) Outline of a general theory of behavior and brain coordination. *Neural Networks*, 37, 120-131. (25th Commemorative Issue)

Bressler, S.L. & Kelso, J.A.S. (2001) Cortical coordination dynamics and cognition. *Trends in Cognitive Sciences*, 5, 26-36.

Jirsa, V.K., Friedrich, R., Haken, H. & Kelso, J.A.S. (1994). A theoretical model of phase transitions in the human brain. *Biological Cybernetics*, 71, 27-35.

Jirsa, V. K., Fuchs, A., & Kelso, J.A.S. (1998) Connecting cortical and behavioral dynamics: Bimanual coordination. *Neural Computation*, 10, 2019-2045.

Kelso, J.A.S., Fuchs, A., & Jirsa, V.K. (1999). Traversing scales of brain and behavioral organization. I-III. In C. Uhl (Ed.), *Analysis of Neurophysiological Brain Functioning*. Springer-Verlag, Berlin, pp. 73-125.

Jirsa, V.K. & Kelso, J.A.S. (2000) Spatiotemporal pattern formation in neural systems with heterogeneous connection topologies. *Phys.Rev. E*, 62, 8462-8465.

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Jirsa, V.K., Fuchs, A., Jantzen, K.J., & Kelso, J.A.S. (2001) Neural field dynamics on the folded three-dimensional cortical sheet and its forward EEG and MEG. In: M.F.Insana & R.M. Leahy (Eds.) *Information Processing in Medical Imaging*. Springer-Verlag Berlin Heidelberg, pp. 286-299. [Francois Erbsmann Prize paper].

Assisi, C.G., Jirsa, V.K., & Kelso, J.A.S. (2005) Synchrony and clustering in heterogeneous networks with global coupling and parameter dispersion, *Physical Review Letters*, 94, 018106

Computational Modeling of Neural Coordination

Kelso, J.A.S. (1991). Behavioral and neural pattern generation: The concept of Neurobehavioral Dynamical System (NBDS). In H.P. Koepchen & T. Huopaniemi (Eds.), *Cardiorespiratory and Motor Coordination*, pp. 224-238, Springer-Verlag, Berlin.

Nagashino, H. & Kelso, J.A.S. (1992). Phase transitions in oscillatory neural networks. *SPIE, Vol 1710, Science of Artificial Neural Networks*, Washington, DC. Pp. 279-287.

Wade, J.J., McDaid, L.J., Harkin, J., Crunelli, V., & Kelso, J.A.S. (Eds.) (2013). **Biophysically-based computational models of astrocyte~neuron coupling and their functional significance**. *Frontiers in Computational Neuroscience* Available at http://www.frontiersin.org/books/all_books

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The Significance of Metastable Coordination Dynamics

Kelso, J.A.S. (1992). Coordination dynamics of human brain and behavior. *Springer Proc. in Physics*, 69, 223-234

Kelso, J.A.S., DeGuzman, G.C. & Holroyd, T. (1991). The self-organized phase attractive dynamics of coordination. In A. Babloyantz, (Ed.), *Self-organization, Emerging Properties and Learning*, Series B, Vol. 260 41-62, Plenum, New York.

Kelso, J.A.S. & DeGuzman, G.C. (1991). An intermittency mechanism for coherent and flexible brain and behavioral function. In J. Requin & G.E. Stelmach, (Eds.), *Tutorials in Motor Neuroscience*, 305-310, Kluwer, Dordrecht.

Kelso, J.A.S., Case, P., Holroyd, T., Horvath, E., Raczaszek, J., Tuller, B. & Ding, M. (1995). Multistability and metastability in perceptual and brain dynamics. In P. Kruse & M. Stadler (Eds.) *Ambiguity in Mind and Nature*. Heidelberg: Springer-Verlag, pp.159-185.

Kelso, J.A.S. (2001). Metastable coordination dynamics of brain and behavior. *Brain and Neural Networks (Japan)* 8, 125-130.

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Kelso, J.A.S. (2010) Metastable mind. In D. Hauptmann & W. Niedlich (eds) *Cognitive Architecture. From Bio-Politics to Noo-Politics*. Rotterdam, 010 Publishers, pp.116-138.

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1/f fluctuations

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Chen, Y., Ding, M., & Kelso, J.A.S. (1997). Long term memory processes ($1/f^\alpha$ type) in human coordination. *Physics Review Letters*, 79, 4501-4504.

Treffner, P. J. & Kelso, J.A.S. (1999). Dynamic encounters: Long memory during functional stabilization. *Ecological Psychology*, 11, 103-137.

Kelso, J.A.S. (2000). Fluctuations in the coordination dynamics of brain and behavior. In: P. Arhem, C. Blomberg, & H. Liljenstrom. (Eds.). *Disorder versus order in brain function: Essays in Theoretical Biology*. World Scientific. Singapore, pp.185-205.

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Coordination Dynamics

Books and Encyclopedia Articles

Kelso, J.A.S. (1995). *Dynamic Patterns: The Self-Organization of Brain and Behavior*. Cambridge, MA: The MIT Press. [Paperback edition, 1997, 4th Printing].

Kelso, J.A.S. (2001) Self-organizing dynamical systems. In Smelser, N.J. & Baltes, P.B., (Eds. in Chief) *International Encyclopaedia of Social and Behavioral Sciences*. Amsterdam; Pergamon.

Kelso, J.A.S. (2009). Coordination Dynamics. In R.A. Meyers (Ed.) *Encyclopedia of Complexity and System Science*, Springer: Heidelberg (pp. 1537-1564).

Kelso, J.A.S. (2014) Invited Article "Coordination". In R.C. Eklund & G. Tenenbaum (Eds.) *Encyclopedia of Sport and Exercise Science*, Vol.1, 174-176.

Jirsa, V.K. & Kelso, J.A.S. (Eds.), (2004). *Coordination Dynamics: Issues and Trends*. Springer-Verlag, Berlin, Heidelberg.

Kelso, J.A.S., & Engstrom, D. A. (2006). *The Complementary Nature*, Cambridge, MA: The MIT Press. Paperback Edition, March 2008.

Discovery of Coordinative Structures/Functional Synergies in Voluntary Movement

Kelso, J.A.S., Southard, D., & Goodman, D. (1979). On the nature of human interlimb coordination. *Science*, 203, 1029-1031.

Kelso, J.A.S., Holt, K.G., Turvey, M.T. & Kugler, P.N. (1980). Coordinative structures as dissipative structures II. Empirical lines of convergence. In G. E. Stelmach & J. Requin (Eds.), *Tutorials in motor behavior* (pp. 49-70). Amsterdam: North Holland.

Kugler, P.N., Kelso, J.A.S., & Turvey, M.T. (1980). Coordinative structures as dissipative structures I. Theoretical lines of convergence. In G.E. Stelmach & J. Requin (Eds.), *Tutorials in motor behavior* (pp.1-40). Amsterdam: North Holland.

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The Coordination Dynamics of Discrete Movement Generation

Kelso, J.A.S. (1977). Motor control mechanisms underlying human movement reproduction. *Journal of Experimental Psychology: Human Perception and Performance*, 3, 529-543.

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The Coordination Dynamics of Rhythmic Movement Coordination: Behavior and Brain

Kelso, J.A.S., Holt, K.G., Rubin, P. & Kugler, P.N. (1981). Patterns of human interlimb coordination emerge from the properties of non-linear oscillatory processes: Theory and data. *Journal of Motor Behavior*, 13, 226-261.

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The Coordination Dynamics of Sensorimotor Processes: Brain and Behavior

Kelso, J.A.S., Fuchs, A., Holroyd, T., Lancaster, R., Cheyne, D., & Weinberg, H. (1998) Dynamic cortical activity in the human brain reveals motor equivalence. *Nature*, 392, 814-818.

Oullier, O., Jantzen, K.J., Steinberg, F.L., & Kelso, J.A.S. (2005). Neural substrates of real and imagined sensorimotor coordination. *Cerebral Cortex*, 15(7), 975-985.

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Multi-limb Coordination: Experiment & Theory

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Schöner, G., Jiang, W.-Y., & Kelso, J.A.S. (1990). A synergetic theory of quadrupedal gaits and gait transitions. *Journal of Theoretical Biology*, 142, 359-391.

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Multifrequency Coordination: Experiment & Theory

Kelso, J.A.S. & DeGuzman, G.C. (1988). Order in time: How the cooperation between the hands informs the design of the brain. In H. Haken (Ed.), *Neural and Synergetic Computers*, Springer, Berlin, pp. 180-196.

DeGuzman, G.C. & Kelso, J.A.S. (1991). Multifrequency behavioral patterns and the phase attractive circle map. *Biological Cybernetics*, 64, 485-495.

Assisi, C.G., Jirsa, V.K., & Kelso, J.A.S. (2005) Dynamics of multifrequency coordination using parametric driving: Theory and Experiment. *Biological Cybernetics*, 93, 6-21.

'Anchoring' / Parametric Stabilization: Experiment & Theory

Fink, P., Kelso, J.A.S., Jirsa, V.K., & Foo, P. (2000). Local and global stabilization of coordination by sensory information. *Experimental Brain Research*, 134, 9-20.

Foo, P., Kelso, J.A.S., & deGuzman, G. C. (2000). Functional stabilization of unstable fixed points: Human pole balancing using time-to-balance information. *Journal of Experimental Psychology. Human Perception and Performance*, 26, 1281-1297.

Jirsa, V.K., Fink, P., Foo, P., & Kelso, J.A.S. (2000). Parametric stabilization of biological coordination: A theoretical model. *Journal of Biological Physics*, 26, 85-112.

Recruitment and annihilation of new degrees of freedom: Experiment & Theory

Kelso, J.A.S., Buchanan, J.J., DeGuzman, G.C. & Ding, M. (1993). Spontaneous recruitment and annihilation of degrees of freedom in biological coordination. *Physics Letters A*, 179, 364-368.

Buchanan, J.J. & Kelso, J.A.S. (1999). To switch or not to switch: Recruitment of degrees of freedom stabilizes biological coordination. *Journal of Motor Behavior*, 31, 126-144.

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Trajectory Formation: Experiment & Theory

Buchanan, J. J., Kelso, J. A. S., & Fuchs, A. (1996). Coordination dynamics of trajectory formation. *Biological Cybernetics* 74, 41-54.

Buchanan, J. J., Kelso, J. A. S., de Guzman, G. C. (1997). The self-organization of trajectory formation: I. Experimental evidence. *Biological Cybernetics*, 76, 257-273.

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Intentional dynamics: Experiment & Theory

Kelso, J.A.S., Scholz, J.P. & Schöner, G. (1988). Dynamics governs switching among patterns of coordination in biological movement. *Phys. Lett. A* 134, 8-12.

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Self-Organizing Origins of Agency

Kelso, J.A.S. (2002). The complementary nature of coordination dynamics: Self-Organization and the origins of agency. *Journal of Nonlinear Phenomena in Complex Systems*, 5, 364-371.

Kelso, J.A.S. (2016). On the self-organizing origins of agency. *Trends in Cognitive Sciences*, 20 (7), 490-499
<http://dx.doi.org/10.1016/j.tics.2016.04.004>

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Social Coordination Dynamics: Experiments and Theory

Animals, People, Neuromarkers, and Sports

Lagarde, J., Peham, C., Licke, T., & Kelso, J.A.S. (2005) Coordination dynamics of the horse~rider system. *Journal of Motor Behavior*, 37, 419-424.

Oullier, O., DeGuzman, G.C., Jantzen, K.J., Lagarde, J., & Kelso, J.A.S. (2008) Social coordination dynamics: Measuring human bonding. *Social Neuroscience*, 3, 178-192. DOI:10.1080/17470910701563392

Oullier, O., & Kelso, J.A.S. (2009). Social coordination from the perspective of coordination dynamics. In R.A. Meyers (Ed.) *Encyclopedia of Complexity and Systems Science* Springer: Heidelberg (pp. 8198-8212).

Tognoli, E., Lagarde, J., DeGuzman, G.C., & Kelso, J.A.S. (2007) The phi complex as a neuromarker of human social coordination. *Proceedings of the National Academy of Sciences*, 104, 8190-8195 (from the cover; see also *Scientific American Mind*, August, 2007).

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Tognoli, E. & Kelso, J.A.S. (2015). The coordination dynamics of social neuromarkers. *Frontiers in Human Neuroscience*, 9, 563, <http://dx.doi.org/10.3389/fnhum.2015.00563>

Correia, V., Passos, P., Araújo, D., Davids, K., Diniz, A., & Kelso, J.A.S. (2014) Coupling tendencies during exploratory behaviors of competing players in rugby union dyads. *European Journal of Sport Science*.
Doi:10.1080/17461391.2014.915344

Nordham, C.A., Tognoli, E., Fuchs, A., & Kelso, J.A.S. (2018) How interpersonal coordination affects individual behavior (and vice-versa): Experimental analysis and adaptive HKB model of social memory. *Ecological Psychology*
<https://doi.org/10.1080/10407413.2018.1438196>

People and Machines—Invention of The Virtual Partner Interaction aka Human Dynamic Clamp Paradigm

Kelso, J.A.S., DeGuzman, G.C., Reveley, C., & Tognoli, E. (2009). Virtual Partner Interaction (VPI): Exploring novel behaviors via coordination dynamics. *PLoS ONE*, 4(6):e5749

Dumas, G., DeGuzman, G.C., Tognoli, E. & Kelso, J.A.S. (2014) The Human Dynamic Clamp as a paradigm for social interaction. *Proceedings of the National Academy of Sciences* <http://www.pnas.org/cgi/doi/10.1073/pnas.1407486111>

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Coordination Dynamics of Learning

Experiments

Zanone, P.G. & Kelso, J.A.S. (1992). The evolution of behavioral attractors with learning: Nonequilibrium phase transitions. *Journal of Experimental Psychology: Human Perception and Performance*, *18/2*, 403-421.

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