To Chaos and Back: Finding Order Through Dynamical Systems, Somatic Movement, Trial and Error

General dynamical systems are a key concept and feature found in chaos theory. General dynamical systems are nonlinear, are dependent on past and present influences or events, and that its future state is not random but determined by rules or constraints (Ditto & Munakata, 1995). Dynamic pattern theory in motor control shares the same concept of nonlinearity and that motor behavior is spawned from such. Furthermore, motor behvior is an expression of experiences, influences, and constraints which according to Clark (1995) included physical characteristics, cognitive and psychological states, emotional aspects, environmental, cultural and social circles. Magill (2011) simplified and categorized this notion of "constraints" as either being order parameters or control parameters. Observed motor behavior is not random, but is both specific and determined: "Movements emerge from constraints" (Clark, 1995, p. 175).

Related concepts in chaos theory as described by Oestreicher (2007) are patterns of self-similarity (a building block in fractal theory), fractal theory (patterns of self-similarity taken to the infinity), and attractors (nodes of "stability" where systems tend to evolve into from seeming disorder). Similarly in the dynamic pattern theory of motor control, Magill (2011) redefined attractors as "preferred behavioral states" (p. 99) or as described by Clark (1995) as "stable patterns [of movement]". This concept is demonstrated by Kelso's finger-tapping experiment described by Magill (2011) and the comprehensive body of work by Esther Thelen, referenced by Clark (1995), studying the development of walking in infants (Spencer et al., 2006).

Transitional movement behaviors are unstable (Clark, 1995) and yield to nodes of stability (attractors). The tendency of movement is towards some kind of stability. The body tends to adapt to the path of least resistance whether it is expressed as a "good" movement pattern or a "faulty" one. Related to the idea of stable states in movement coordination as described by both Magill (2011) and Clark (1995) are the concepts of self-organization, movement patterning, and coordinative structures. These concepts may be akin to the ideas of fractal theory where units of self-similarity are repeated over and over again to infinity forming fractal patterns which are commonly found in nature.

Although field of somatic movement has many flavors such as the Alexander Technique, the Feldenkrais Method, Hanna's Somatics, and the work by Ida Rolf, the commonalities between them are: a holistic (mind, body, spirit, environment) perspective on movement; a heightened awareness of not just one's body but also the interconnectedness of the mind, body, spirit, and environment; and importance of this "consciousness" in each individual in developing movement from inside to out (Eddy, 2009). Esther Thelen, best known for her work in dynamical systems theory, became a certified Feldenkrais practitioner later in her career not only to complement her existing work, but to open a dialogue between theory and what she saw as an application of dynamical systems.

Magill (2011) noted that dynamical systems theory is concerned with how over a time continuum, systems gravitate towards one stable state to another. Similarly, a feature of the

Feldenkrais Method is to improve, change, and discover new movement patterns within the individual over time (Buchanan & Ulrich, 2001).

Another feature of the Feldenkrais Method is developing an awareness and interconnectedness from within the individual (mind, body, spirit, environment) and translating that into movement explorations that yield not only more efficient movement, but also pain-free movement and movement to enhance daily activities (Buchanan & Ulrich, 2001). This acknowledgement of mind, body, spirit, and environmental influences by Feldenkrais parallels dynamical systems theory's concept of parameters presented by Magill (2011). According to Feldenkrais theory, any changes or disturbances in the above "parameters" can lead to change and instability--the need to evolve to the next stable state or preferred movement pattern.

Self-organization and attractor states are key ideas from chaos theory and dynamical systems theory. The principle of self-exploration in finding a movement solution is key in the Feldenkrais Method. During a Feldenkrais session, clients are not always explicitly told how or what to do (pertaining to movement) but they are guided by the instructor to consciously explore movement (Buchanan & Ulrich, 2001). The theory is that out of many movement possibilities, the most appropriate and best movement pattern for a particular individual will emerge (out of the "chaos" of experimentation), and self-organize (Buchanan & Ulrich, 2001). Movement behaviors can change over time due to various influences and move from one "preferred" state to another (Buchanan & Ulrich, 2001) akin to attractors in dynamical systems theory.

Furthermore the concept of perception-action coupling (Magill, 2011) is shared by both dynamical systems theory and the Feldenkrais Method. Both theories acknowledge the importance of sensory information in the performance of movement patterns and the development of refined, skillful prractice (Buchanan & Ulrich, 2001).

Chaos theory is one way to explore many different systems from economics, finance, and art to physics, biology, and medicine. Dynamical systems theory in the context of motor control theory is closely related to features of chaos theory. The Feldenkrais Method and general theories of somatic movement share similar principles to dynamical systems theory. Somatic movement practices especially in body awareness and conscious movement may be able to enhance current programs in rehabilitative medicine and athletic skills development. In addition, somatic movement applications combined with "deliberate practice" and contextual interference may enhance skills development towards expertise.

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Addendum: To tie into threads in Discussion 1 and Discussion 2.

The question was raised: Should we let students "figure things out" on their own? In teaching, there is that element of allowing the student to "figure things out" on their own. The Feldenkrais Method supports this nature of exploration towards improvement and self-efficacy. After a student has "figured things out", is that an expression of a stable state (attractor)?

There is a certain amount of "trial and error" in the approach to "figuring things out". I challenge the degree of randomness in "trial and error". Are there constraints and parameters in "trial and error" as far as available options regarding the individual and environment? Does "trial and error" fit into chaos and dynamical systems theory? Is the "solution" that emerges from "trial and error" in fact an expression of a stable state?

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References

Buchanan, P. A., & Ulrich, B. D. (2001). The Feldenkrais Method: a dynamic approach to changing motor behavior. *Research Quarterly For Exercise & Sport, 72*(4), 315-323.

Clark, J.E. (1995). On becoming skillful: Patterns and constraints. *Research Quarterly for Exercise and Sport, 66*(3), 173-183.

Magill, R. A. (2011). *Motor learning and control: Concepts and applications* (9th ed.). New York, NY: McGraw Hill.

Ditto, W., & Munakata, T. (1995). Principles and applications of chaotic systems. *Communications of the ACM, 38*(11), 96-102.

Eddy, M. (2009). A brief history of somatic practices and dance: Historical development of the field of somatic education and its relationship to dance. *Journal of Dance & Somatic Practices, 1*(1), 5-27.

Oestreicher, C. (2007). A history of chaos theory. *Dialogues in Clinical Neuroscience, 9*(3), 279-289.

Spencer, J. P., Corbetta, D., Buchanan, P., Clearfield, M., Ulrich, B., & Schöner, G. (2006). Moving Toward a Grand Theory of Development: In Memory of Esther Thelen. *Child Development, 77*(6), 1521-1538.