Smith and Thelen - Dynamic Systems Theory

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Dynamic Systems Theory (DST) is a broad, versatile framework used to investigate a variety of questions concerning the world and the systems that make it up. As applied to developmental psychology, DST views the human person as a system made up of and acting within other systems. Systems are any set of functions or behaviors that work together to influence, or be influenced by, other functions and behaviors. A system can be defined at various levels – cognitive processes, the human person, societies – but all systems change and shift over time. This shifting and changing often occurs within similar sets of constraints, so the patterns that emerge from the systems are often predictable. In the case of human development, human beings develop within constraints that are particular to our species (i.e., human beings have two arms and two legs, large brains relative to other species, and live in social groups).

Systems can be closed or open. Closed systems do not allow energy to leave or enter the system, but open systems do. Human beings are open systems – the energy entering or leaving the system causes movement between stability and instability, from one pattern to another. Systems have a higher likelihood of settling into particular patterns - these patterns are called attractor states. For example, the human body stays at an average temperature of 98.6 degrees Fahrenheit. Repellor states are patterns the system has a lower likelihood of settling into. For example, when sick, individuals may have an elevated temperature, or fever, as the body fights off the illness, but the body will not stay at that elevated temperature.

Stability in a system can be defined in various ways. While the different types of stability are all important to a broad understanding of DST, relative stability is most important to

understanding DST as it applies to development. As already discussed, human beings are open systems, and energy coming into the system can cause it to shift. With enough energy, the system could shift into a different pattern. This potential movement between patterns is what is referred to as relative stability. Some systems are relatively less stable than others, meaning less energy is needed to shift the system into a new pattern. Continuing with our body temperature analogy, some individuals may be pre-disposed toward developing fevers when fighting off illnesses. For these individuals, it takes less energy to shift the system into a fever pattern. In the context of development, the energy added to a system could be anything from deficits like improper nutrition to a lack of opportunity for education, to opportunities like enriched environments or responsive, supportive caregivers. These different kinds of 'energy' all have the potential to alter the course development would take given specific constraints. Relative stability helps us to understand how two individuals can develop in different ways within the same constraints.

When we look at the constraints the human person develops within, combined with the system patterns the developing person is likely to settle into, and the relative stability of those patterns, it may appear as though the course of human development is forced to march along the same path time after time. Human beings seem to have no choice but to crawl before walking, or to babble before speaking, but DST views these progressions in development as systems reacting to other systems, sometimes merging with one another, but always subject to the relative stability of each system. Smith and Thelen talk about the course of human development as being 'softly assembled.' At no point does development have to occur the way it does – with the appropriate amount of energy, the system can be shifted off course – but in the majority of cases, development will occur along a very similar path.

Dynamic Systems Theory has been applied to multiple areas of development, including the development of motor behavior (reaching), perceptual & cognitive development (object permanence), language development (shape bias), and socioemotional development (mother-infant communication).

Further Reading:

Beebe, B., Messinger, D., Bahrick, L. E., Margolis, A., Buck, K. A., & Chen, H. (2016). A systems view of mother–infant face-to-face communication. *Developmental Psychology, 52*(4), 556-571.

Mulder, H., Oudgenoeg-Paz, O., Hellendoorn, A., & Jongmans, M. J. (2017). How children learn to discover their environment: An embodied dynamic systems perspective on the development of spatial cognition. In A. Postma & I. J. M. van der Ham (Eds.), *Neuropsychology of Space: Spatial Functions of the Human Brain* (pp. 309-360). Boston, MA: Academic Press.

Perone, S. & Simmering, V. R. (2017). Chapter two – Applications of dynamic systems theory to cognition and development: New frontiers. *Advances in Child Development and Behavior (52)*, 43-80. doi: 10.1016/bs.acdb.2016.10.002.

Yu, C., & Smith, L. B. (2017). Multiple sensory-motor pathways lead to coordinated visual attention. *Cognitive Science*, *41*(S1), 5-31.