The Feldenkrais Method and Dynamic System Principles

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These notes were originally written to Esther Thelen in order to introduce her to the Feldenkrais Method after reading, with great appreciation, her book, A Dynamic Systems Approach to the Development of Cognition and Action.

Moshe Feldenkrais was a brilliant innovator of movement education techniques, and as a theorist, far ahead of his time in anticipating new concepts in movement and cognitive sciences. Feldenkrais's approach to movement education is unique in its embodiment of dynamics systems concepts.

Conventional exercise and physical education methods involve strictly following position indications for good form or posture, literal movement instructions and imitation of visual models. These methods are consistent with hierarchical motor control theories that maintain that "higher centers" or a homunculus can order the body through commands to learn new postural and movement patterns. Feldenkrais believed that these approaches were based upon an incorrect theory of control and that in actual practice, conscious self-direction alone does not elicit functional learning. Rather, he believed, functional learning emerges through pursuing exploratory variations constrained and facilitated by functional demands and the environment.

Feldenkrais often likened his movement lessons, which he hated to be called "exercises," because of connotations of mechanical repetition, as scientific experiments, demonstrating over and over again how human beings would come up with similar solutions to motor problems, based upon common features of structure and function and common environment and task demands. Common solutions will tend to emerge without instructions or imitation, and despite very different initial postural and movement patterns. His thousands of lessons were created partially in order to test his hypotheses regarding the nature of motor learning.

In contrast to explaining movement solely in terms of anatomy and kinesiology he said one must understand the "organization" of movement, meaning its embodied, intentional, contextual nature, i.e. how one organizes an action in an environment in order to meet various criteria of action, including biomechanical and energetic factors as well.

Feldenkrais understood well the nonlinear nature of change. Small differences in any aspect of the task or environment may trigger nonlinear changes in an action. His methods embodied a way to discover empirically which control parameters might be efficacious for the learning of more advantageous movement and postural behavior. He believed that sensitivity to the requirements of learning are crucial, and that mechanical repetition, forced stretching or manipulation, could not be primary agents for changing patterns of action.

In contrast to teaching improved posture by adopting a position specified by a visual reference such as a plumb line or grid, Feldenkrais emphasized that posture was a component of action,

and must be learned in the real time situation of meeting task demands. Far from being a position, Feldenkrais's 1940's formulation of "acture" closely resembles chaos models. Posture can be well represented as an attractor defined as a zone of stable variation including many positions constrained by task demands, balance, biomechanics, support surface and many other factors. The chaotic, yet highly organized movements present even in "static" posture, called "postural sway," demonstrate the impossibility of adopting a truly fixed upright position, whether it is deemed good or bad.

In order to induce the instability necessary for phase shifts in a system from one highly stable attractor to another, Feldenkrais developed many techniques including novel tasks, novel environments, novel spatial orientations and effort substitutions.

Here are a few examples of how Feldenkrais taught improved posture:

a) One series of lessons includes variations on standing and oscillating. Stand and oscillate forwards and backwards, then side to side, first with feet apart, then will feet together, sometimes with eyes open, sometimes with eyes closed, then make circular movements in one direction, then in another. In the second series of variations one leg is placed in front of the other, and in the next series one stands with the arms in front of behind or out to the sides in various combinations.

Exploring these movement variations destabilizes existing postural attractors and a new attractor emerges defined as a zone of easy movement in all directions further specified by the extra balancing requirements of narrow stance and omitted visual cues.

b) Standing and turning reorganizes posture in a manner compatible with the situation of turning and seeing to the side. Our habitual posture may be disposed toward primarily forward movement or fairly static orientation.

c) In a quadrapedal posture, on hands and feet, one alternately lifts one hand and the other, one foot then the other, right hand and foot together, then left, then right hand with left foot, then the other diagonal, then both hands, both feet, and finally hopping with all four lifted at once. While initial placements of the arms and legs vary enormously among individuals, a large group of people will converge upon the same posture. The task demands of the that situation impose similar solutions, despite disparate positions and movement trajectories during the destabilized, highly exploratory phase.

In contrast to conventional physical therapy which has emphasized the primarily mechanical factors of muscle strength and flexibility, and skeletal alignment and mobility, Feldenkrais saw how many postural and movement problems are tied to behavioral habits, including cognitive, motor, environmental and perceptual aspects. In conventional therapy, neurological patients are typically given regimes of passive stretching. In Feldenkrais work, for example, a child with cerebral palsy is never passively stretched. It can be demonstrated that an elbow which will not normally bend, except with extreme force, may bend easily if the child is moved in an exploratory way such that she perceives the value of bending the elbow for leaning on it in order to sit up. Movements and exercises without imbedded functional values are superficial, and may

represent little more than noise to a nervous system seeking multi-modal correlation between rich sources of movement and perceptual information related to value laden action trajectories toward desired goals.

Another striking example is Feldenkrais's systemic view of chronic pain. Rather than residing in some literal way "in the body" Feldenkrais understood most musculo-skeletal pain (except the pain of immediate trauma) as expressing a pattern of action, a habit embodying emotional, biomechanical, neuro-chemical and other components. Change the pattern and you can eliminate the pain, despite structural problems. Examples of how this is done include:

a) Let us say a given joint such as the shoulder is painful when raising the arm. Feldenkrais discovered that he could move the proximal side of the joint, that is, move the scapula relative to the humerus, without pain. Thus, due to contextual differences, one may obtain a kinematically isomorphic movement which is categorically not perceived as such by the person. This proximally induced movement is completely pain free to the individual and does not trigger the protective, defensive reactions of the more normal, distally evoked movement. This technique so destabilizes the system, enabling new patterns, that after a few repetitions of the proximal movement, the normal distal movement may be accomplished without pain as well.

b) Often a movement is painful in one orientation but not another. Take, for example, flexing on the back, i.e., lifting the head and bring an elbow forward toward the opposite knee, while lifting the knee toward the elbow. If a similar movement is done in the sitting position, or leaning on one's hands and knees, there may not be pain. Once the initial movement is performed again on the back, it is usually done without pain, and with greater flexibility and coordination. These variations in orientation alter the degree of anti-gravity muscular work, change spatial relations, generate new proprioceptive information and, most importantly, change the action category. By dissociating the movement from its habitual context, it demonstrates to the system that a movement is not dangerous, and it ceases being painful.

c) In cases of orthopedic or neurological problems, novel movements are often first taught on the "better" side of the body, the side that is uninjured, not painful, less stiff, and/or under better neuro-motor control. Many movements of the body are reciprocal, e.g., the ability to shorten and lengthen one leg is the same, with respect to the pelvis, as the lengthening and shortening of the opposite leg. It is significant that even though the movements are physically isomorphic, movements performed on the right or left sides of the body are nonetheless perceptually dissimilar. This fact is very useful for learning new patterns.

By manipulating the environment of familiar task demands, it is possible to destabilize attractors and help new ones to emerge:

a) *Alteration of spatial orientation*. One lesson provides a radical demonstration of the context-based nature of learning, and the importance of spatial orientation as an essential, though tacit, component of action. One is asked to perform a fairly simple series of foot movements, including supination and pronation, dorsi and plantar flexion, and rotation while lying on one's stomach, with the knees bent at right angles to the ground. Although most people would have no difficulty whatsoever in performing these movements in a seated position, in this altered physical position

most people are utterly incapable of doing them. Even when they can be clumsily performed, without visual feedback people are often incapable of discriminating the position of their feet in space and which movement their feet are actually doing! The lesson then proceeds with augmenting the movement by visually tracking the foot. This, interestingly enough, destabilizes the action further, making the person even more confused, disoriented and uncoordinated. This is a good example of Edelman's multi-modal reentrant processing concept: since the person has never correlated their foot movements with visual cues in this position, the visual tracking does not refine the movement, as one would expect, but adds another perceptual-action demand to the task space. Soon, however, the visual cues, do help people learn the necessary coordination. Even more helpful, however, is that students are asked to perform similar movements in different positions—standing, lying on the back, etc., until they are able to transfer and generalize information to the novel position of lying on the stomach.

b) *Alteration of the environment*. In Functional Integration, the primarily hands-on technique, the student may be placed upon rollers (tubes made of cardboard or plastic material or rolled blankets) of various sizes in various orientations. For example, the student may be asked to lie on a long narrow roller placed lengthwise under the spine. This environment creates novel balancing requirements, because it is easy to fall off the roller. The practitioner moves the student in a variety of ways in order to elicit the emergence of different postural and movement patterns adequate to deal with the roller's pressure and balancing requirements.

Support

One of the most significant alterations of the environment is created by the Feldenkrais practitioner providing conditions of greater support . Just as research showed how infant stepping could be re-elicited in the more supportive environment of water, so too many actions are easier to learn, and previously acquired abilities easier to elicit, when greater support is provided. In Awareness through Movement, simply doing movements while lying down enables people to perform various movements they are unable to do while upright, Presumably this is due to lessened anti-gravity muscular effort, the reduction or elimination of balancing requirements, increased proprioception due to a greater surface area when contacting the floor, and heightened kinesthetic sensitivity.

Part of Feldenkrais's rationale for utilizing support was a perceptual argument that a Weber-Fechner phenomenon was at work, enhancing those discriminations needed for learning. Just as smaller changes in illumination are perceivable against lower levels of background illumination, Feldenkrais claimed that smaller changes in muscular efficiency may be registered against a background of reduced effort. For this reason Feldenkrais often advised students to use small, even minuscule movements in the initial stages of learning. When an action is facilitated through support it reduces muscular effort thereby lowering the threshold at which differences in movement organization can be perceived and learned.

In Functional Integration support may be provided by lying on rollers, pillows and surfaces that lessen muscular effort, and especially through use of the practitioner's hands in ways that support the body of the student in order to relieve postural work that the system is engaged in. In a Gibsonian sense support is understood not in a purely mechanical sense, but in the ecological

sense that the surface provided to the student is perceived as affording reliable support for action. This enables relief from postural muscular effort, and enlarges the field of action-perception possibilities.

Furthermore, in light of Fogel's concept of co-regulation, providing support can be understood as helping establish communication within the framework of the activity. Relevant information about the activity is conveyed as participants negotiate their relative share of an action's effort.

Of particular interest—because of their practical value and theoretical challenge—are highly sophisticated manual procedures often done while the student lies down on a treatment table, involving perhaps pushing through the feet or lifting the spine or head. If performed accurately, and it takes many years of training to accomplish it, it is possible to support, and therefore convey information about, enormously complex patterns of postural behavior. Feldenkrais went so far as to say you could create in the brain a tabula rasa from the person's habitual patterns. Obviously an overstatement at best, still what one observes is an enormous destabilization of attractors. An incredible degree of plasticity comes about, enabling the system to enter many novel attractor states.

Feldenkrais emphasized how any new movement learning always exploits previous learning and the inherent possibilities of the system. For example:

a) In an early approach to self-defense techniques he developed back in Palestine in the late teens, Feldenkrais watched the spontaneous defensive reactions of individuals to a knife attack. He then invented a defense technique that was grafted on to and tuned this already existing pattern.

b) In the teaching of a new behavior, we often tune or refine existing movement patterns, irrespective of ideas about "normalcy" that often constrain rehabilitation therapists. For example, when teaching a person to walk again after a joint injury, we might facilitate the limping pattern that emerged as the person's way of coping with the trauma. Then we may gradually enlarge the repertoire by shifting the environment or altering task demands. If, on the contrary, as some therapists do, one ignores the existing, adaptive pattern, and tries to forcibly move the person through a "normal" range, the person may defensively react (in effect, become more stable in their pain avoidance pattern) and be unreceptive to new learning. Feldenkrais emphasized that one needs a learning theory, and not just orthopedics, to account for the adaptive changes that occur post-trauma. And the job of rehabilitation is not just mechanical but, rather, systemic. After a serious injury and healing, even under the best circumstances, one does not simply recover function and behave identically to one's previous patterns. Post-traumatic behavior is a creative solution to a unique problem of action. Furthermore, it is possible to learn better function, through new means, than one had before.

c) *Intrinsic system dynamics*. Feldenkrais invented many series of lessons that explore and utilize intrinsic system dynamics, similar in some respects to the Kelso experiments. Some of these entail oscillatory movements generated through rhythmic ankle flexion, performed while lying on one's back. Because of the pendulum features of these movements, the coordination involves finding how to push off when the kinetic energy of the previous push and return has been

dissipated (like pushing a child on a swing). There is no need to specify the frequency nor the force required, because these will emerge from system dynamics. There is a great improvement in ones posture after doing these variations, presumably because one learns to perceive how efficient compression forces can be exerted through the skeleton (without the need of anti-gravity work) in a manner analogous to the upright postural demand of organizing gravitational compression. In another series of lessons, involving lifting and dropping the legs or other parts of the body, one learn inter-limb coordination that do not depend upon neural coordination but rather structural-functional joint and limb properties. As a physicist Feldenkrais greatly appreciated the fact that movement can have self-organizing properties. As a judo teacher he knew what it meant to utilize gravity, momentum and other physical forces.

Implied here is also the idea that actions contain subsidiary coordinations that when learned, may be transferred to other skills. Feldenkrais understood how to construct and deconstruct action components out of and into subsidiary coordinations. Contrast this with reductionist models of action that emphasize local muscular strength elements.

Goal and non-goal orientation

The use of goals as attractors can be a two-edged sword, and it is important in learning strategies to be flexible about how they can operate as potential control parameters. Goal direction obviously enhances learning by giving a person a better understanding of what is expected and desired, and can help call up memories of how to solve similar problems of action. However, conscious attempts to achieve a goal perceived as impossible can further deepen existing attractor wells. Individuals may have a long history of learning how not to succeed at various tasks dues to pain, poor coordination, lack of strength, etc. Conscious attempts may merely trigger effortful and unsuccessful strategies. This is another reason why Awareness through Movement sequences are as much deconstructive as they are constructive of specific skills. Feldenkrais also often ingeniously invented lessons designed to elicit novel behaviors through the introduction of various constraints which lead to new and unexpected abilities. Examples of "surprise" lesson structures include:

a) Moving the pelvis while sitting in a chair in various ways, triggering standing up efficiently, without the thought of getting up.

b) Lying on the floor, holding one's foot and moving it towards the mouth and other directions, leading to rolling to sit up, without any conscious idea that the lesson was about learning to sit up in a new and more efficient manner. I watched my own son Nathan learn to roll from back to side in precisely this way at the age of three months. Rolling to the side appeared as an accidental consequence of finally putting his big toe in his mouth! This is just one example among hundreds, of how Feldenkrais was a master at utilizing early development movements as a way of furthering many coordinative skills for both children and adults. It also demonstrates that the adult's conception of what the child is learning may not at all be an accurate representation of its developmental trajectories. Many actions are learned in the course of gaining coordinations needed for satisfying other than obvious goals. This is analogous to Gould's remarks on evolutionary change. Organic structures may be exploited for different functions then those they originally served, and so too in learning behaviors.

Due to context sensitivity, environmental familiarity or unfamiliarity is another important variable, acting to trigger or suppress the emergence of previously learned patterns. This can be advantageous or problematic, depending upon whether the patterns are useful.

The stage of destabilization described as preceding phase shifts and new learning, Feldenkrais induced through the introduction of novel task demands. One of the most powerful (and quick to produce) examples involves moving the eyes opposite to the direction of the head in order to induce greater flexibility throughout the body when turning to look to the side. According to Feldenkrais, our inflexibility resides not in our muscles and joints but, rather, in those of our habits that include much unnecessary muscular efforts. Due to the importance of vision for the control of many movements, directing one's eyes in a nonhabitual manner while engaged in an action deeply destabilizes normal movement patterns and enables the emergence of more efficient patterns that are available but suppressed under current circumstances. This approach is incredible effective (and easy to document, I might add), and stands in sharp contrast to prevalent therapeutic modes that strive to either stretch, relax, or strengthen the neck muscles, none of which addresses the dynamic, variable character of action.

Also effective in increasing the neck's range of motion without stretching is simply to move one's eyes many times in a congruent direction to the direction of the head. Deep changes in muscular tonus are elicited such that one can turn one's head and neck much farther in the direction of one's gaze. Feldenkrais liked to explain such effects by invoking neuro-reflex pathways involving tonic adjustment. Here, a better (dynamic systems) explanation would probably be that moving the eyes elicits strong attractors reflecting a long history of coordinated eye and head movements in many visually guided behaviors.

Feldenkrais emphasized how action and perception are inextricably intertwined. The easily misunderstood name for his system of movement education, "Awareness through Movement," reverses the more conventional idea of body awareness. Feldenkrais movements were intended to further knowledge and perception, and not seen as an end in themselves. Only through movement can one perceive oneself and the world, and perception makes movement possible (as Shakespeare said, "Sure you have sense, else you could not have motion."). Also, Feldenkrais emphasized many linkages between motor and cognitive processes. Some examples include: a) In the example mentioned above, involving oscillatory movements, one learns from the body's movement. One can neither say that one instructs the body, nor that the body instructs itself.

b) A series of counting lessons shows how in effect one counts one's own patterned eye movements as much as objects in the world. In other words, counting involves multi-modal correspondences and correlations. The learning of speed reading involves learning how to speed up and smooth out one's movements so they don't stop on individual words, as when one subvocalizes.

c) In lessons involving visualization we learn how there are patterned eye movements and other muscular contractions correlated with attention shifts. For example visualizing the right side of one's body entails eye movements to the right. Exploring in one's mind the shape of one's foot elicits coordinations reflecting a history of putting on socks, getting foot massages, and walking

on various surfaces. So-called "imaginary movement" draws upon our earlier experiences of movement exploration. The training of visualization, perception and action are all intertwined.

The movement variability in all Feldenkrais lessons embodies an important principle from evolutionary and ecological biology— that variation is a key to the potential required for learning and adapting to novel conditions. A well-learned skill embodies sufficient variability for meeting the demands of changing environments and tasks.

Feldenkrais invented thousands of both manual and active techniques in order to facilitate the challenge of unique persons, problems, unique solutions. He did not advocate routines or mechanical exercises of any sort but, rather, an exploratory journey that enhances coordination and abilities, fitting the goals of the individual. Implicit in this work is an attention to micro differences in learning, micro differences in muscular patterns, joint movements, postural dispositions. Many therapies ignore, trivialize or try to wipe out these differences, based upon a Platonic ideal of healthy movement or posture, technologically implemented through machine-like movements often involving the literal coupling of humans and machines. Feldenkrais was a refugee from more than one totalitarian regime and put a high value on human freedom and individual differences.

New research methods and theoretical ideas seem to support much more attention to these individual differences and provide scientific means to learn much more about such differences. It is heartening to see, perhaps for the first time, scientific interest being paid to such a "close-up" view of action and learning.

In the Feldenkrais Method a similar principle is applied, minus the cast or other restraining aids. By assuming somewhat unusual positions in certain lessons, habitual patterns are constrained and movement is forced to travel along different routes, activating parts of the brain and body that, due to habit, might have become underutilized if not dormant.Â That these ideas were utilized by other neuroplasticians places the Feldenkrais Method in a broader context and counters my temptation to conflate his uniquely compelling personal story with the uniqueness of his work. In the words of Salon.com, â€œThe origin of Moshe Feldenkraisâ€™ therapeutic method reads more like a spy thriller than a neuroscience textbookâ€.