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Evidence for the Effectiveness of the Feldenkrais Method

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The Feldenkrais method (FM) is a process that uses verbally and manually guided exploration of novel movements to improve individuals' self-awareness and coordination. This paper reviews recent literature evaluating the therapeutic value of the FM for improving balance, mobility, and coordination and its effectiveness for management of chronic pain. The authors also explore and discuss studies that have investigated some of the other bodily effects and possible mechanisms of action, such as (a) the process of learning itself, (b) focus of attention during motor learning, (c) autonomic regulation, and (d) body image. They found that research clearly supports the effectiveness of the FM for improvement of balance and chronic pain management. The exploration into mechanisms of action raises interesting questions and possibilities for further investigation.

***Keywords*:** awareness through movement, function, functional integration, mechanism of action, pain management

In this paper, we review experimental evidence for the effectiveness of the Feldenkrais method (FM) in changing performance in the areas of general function, mobility, and balance, as well as for pain management. We primarily focus on results from randomized-control-trial (RCT) studies but also include an overview of research examining the effectiveness of the FM and identified areas where little research has been conducted. In addition, we describe research involving some of the internal processes through which the FM is thought to effect changes. We refer to this as *mechanism of action* reluctantly, since no straightforward mechanism is implied (refer to Russell, 2020). Finally, we provide suggestions for future research.

Research on Function, Mobility, and Balance

Two systematic reviews of the evidence for the FM have been reported in the peer-reviewed literature. Ernst and Canter (2005) included six RCT studies of low to moderate quality in diverse populations and concluded that evidence for potential benefits was emerging but unclear. In a later study, Hillier and Worley (2015) combined the evidence base of 20 RCT studies that included a wide variety of participants such as healthy volunteers, healthy older adults, older adults in elderly-care institutions, and individuals with diseases and disorders such as multiple sclerosis, myocardial infarction, and sleep bruxism. The Feldenkrais-based interventions were predominantly variations of Awareness Through Movement (ATM)—the verbally delivered, group-based version of the FM—with active or passive control groups. The effects measured were mostly outcomes related to performance or activity, but other measures included improved quality of life and reduction in pain. Results were pooled for balance measures. Findings from these meta-analyses demonstrated a superior improvement in balance for individuals who participated in the FM compared with controls. This finding was particularly evident for aging populations. Single-study effects were positive for reduced perceived effort (during activity), improved range of motion, decreased pain, increased comfort, improved perception of body image, and dexterity. No studies reported adverse events. This review showed that the additional RCT studies provided strong evidence for improved balance due to Feldenkrais ATM intervention.

Hillier and Worley recently updated their 2015 review using the same methods as previously. This new review has not yet been published. They included seven new RCT studies with sufficient strength of design to meet quality standards. Each study had a different population and different reported outcomes. For example, Brummer, Wallach, and Schmidt (2018) conducted individual lessons with healthy adults—one group received the intervention targeting the left side of their body and the other targeting the right side. Their results confirmed a significant change in surface contact and pressure for the targeted side, confirming that the FM does seem to offer specific sensorimotor change depending on where awareness is directed. Causby, McDonnell, Reed, and Hillier (2016) investigated the use of ATM to improve manual dexterity in scalpel use in podiatric-medicine students. Compared with students who received only physical practice, the ATM group did not experience additional benefits. Palmer (2017) found that healthy older adults randomly assigned to an FM group improved significantly on key balance measures compared with those randomly assigned to a control group.

Teixera-Machado et al. (2015) examined the effects of the FM on people with Parkinson's disease. Participants were randomly assigned to either an FM program or a standard program in which they received education and advice. The researchers found that the FM group demonstrated superior benefits in improved quality of life and reduced depression compared with the standard program. Torres-Unda et al. (2017) investigated the effects of the FM on individuals with mild intellectual disability. Participants were randomly assigned to either ATM or no intervention. Those receiving the intervention significantly improved balance and mobility, demonstrating that individuals with intellectual disability can benefit from ATM.

Three studies were initially considered in the updated review but were excluded as they did not use randomization or reported insufficiently objective measures. One of these studies, conducted by Cook, LaRoche, Swartz, Hammond, and King (2014), reported

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that healthy women who participated in the FM experienced improved quality of life, mobility, and balance compared with a control group that maintained normal daily activities. In addition, Ulmann (2016) conducted a case series with two older women with impaired cognitive function. Those participants demonstrated improved cognitive function based on performance in the Trail Making Test. Moreover, Wu et al. (2015) and Barnes et al. (2015) investigated the use of a composite intervention of body-awareness exercises (Preventing Loss of Independence through Exercise [PLIÉ]) that included the FM in an RCT study with a small group of people with dementia. Wu et al. (2015) used a qualitative assessment of outcomes, while Barnes et al. (2015) reported quantitative functional results. Both sets of authors concluded that the sample was too small to demonstrate significant results; however, they agreed that, together, these and other earlier studies showed promise for improving physical and cognitive function and quality of life in people with dementia and a reduction in caregiver stress, and the topic thus deserves further research. Their findings, along with Ulmann's (2016), demonstrate that this method can be effectively used with people with dementia.

Feldenkrais Research on Pain Management

According to Manchikanti and Hirsh (2015), chronic low back pain (CLBP) is the leading cause of disability. In a review of noninvasive treatments for CLBP, Quaseem, Wilt, McLean, and Forciea (2017) recommended motor-control training along with a number of exercise and mindfulness approaches in lieu of pharmacologic and other more invasive approaches before considering surgery. Physical therapists have traditionally approached pain as a tissue-specific problem, developing special tests to identify tissues involved before developing a treatment plan. Recently, Salamh and Lewis (2020) suggested that these assessments in the case of chronic shoulder pain no longer have a valuable clinical function. They gave suggestions for approaching a chronic pain exam but did not include coordination as a factor. Coordination, as defined by Turvey (as cited in Magill & Anderson, 2017, p. 89), is the "patterning of head, body and limb movements relative to the patterning of environmental objects and events" during the performance of a task. Over the past 8 years, research has begun to focus on movement coordination as a significant factor in pain management (Cote, 2012; Kibler, Wilkes, & Sciascia, 2013; Klintberg et al., 2015; Lefevre-Coulau et al., 2018; Rowley, Smith, & Kulig, 2019; Arumugam et al., 2020). This is supported by a growing understanding of a neuroscience approach to pain combined with training using cognition-targeted motor control (Nijs et al., 2014). The central focus of the FM is learning and relearning coordination of movement patterns (refer to Russell, 2020).

The following review is not exhaustive except in the case of RCT studies. Chronic pain is a very common presentation to Feldenkrais practitioners. Almost every practitioner has had personal experience of his or her own pain problems resolving through ATM or functional-integration (FI) experience. FI is similar to ATM in that it involves a slow, gentle exploration of movement possibilities; however, unlike ATM, which is presented verbally to a group or an individual, FI is a one-on-one, hands-on interaction between a teacher and a student in which the teacher works gently through movement biases and kinesthetic idiosyncrasies presented by the student. FI is a primarily manual interaction process. It is not unusual for students to come out of a Feldenkrais lesson with a feeling of lightness in their body, an ease in their movement, and diminished or absence of pain.

Much of the early investigation into the effectiveness of the FM involved pain management. Ives and Shelley (1998) reviewed this early literature and reported that the levels of evidence represented were primarily expert opinion, case control, and case study. They stated that no conclusion could be drawn regarding effectiveness but that the overwhelming balance of the evidence suggested effectiveness and that more research was definitely warranted. Case studies on the effectiveness of the FM in the management of pain are very rich. There are dozens of published case studies; we will briefly mention two. First, Lake (1985) reported resolution of LBP in three patients, and second, Myers (2016) more recently reported resolution of lumbar pain and return to running in a female runner with adolescent idiopathic scoliosis.

Findings from two nonexperimental studies have shown the effectiveness of the FM on pain management. Bearman and Shafarman (1999) reported improved pain management and a 40% cost reduction in people with chronic pain over the course of a 1-year follow-up period, while Pugh and Williams (2014) reported qualitative results from 11 participants who had an average of 27 years of CLBP diagnosis. Improvement of LBP and empowerment to perform activities of daily living that had previously been impaired were the primary outcomes of this study.

As of May 2020, there were four RCT studies published that examined the effectiveness of the FM in management of chronic pain. In a systematic review of CLBP interventions, Paolucci et al. (2018) examined six different "exercise" interventions including the FM, Pilates, the McKenzie method, global postural rehabilitation, proprioceptive neuromuscular facilitation, and back school. The FM was assessed to be as good in relation to pain management as any of the other holistic approaches, and better than the pharmacologic or traditional instrumental techniques (e.g., stretching, traction, ultrasound, and electrical stimulation of various kinds).

In an RCT study involving the FM as an intervention, Lundblad, Elert, and Gerdle (1999) studied 97 female workers with neck and shoulder problems. The workers were divided into three groups for 16 weeks of treatment: ergonomic-based physiotherapy with a body-mechanics focus, the FM involving both FI and ATM, and no-treatment/control. The FM group reported decreased complaints of neck and shoulder problems, as well as decreased leisure-time disability, compared with both the ergonomic-based physiotherapy treatment and the no-treatment/control groups at 1-year follow-up. The authors attributed the superior outcomes to the slow, repetitious learning approach of the FM, supporting findings from Parenmark, Engvall, and Malmkvist (1988), who reported similar benefits for slow methodical instruction of line workers in a Volvo plant compared with people who were thrown into the job at full speed.

Malmgren-Olsen, Armelius, and Armelius (2001) compared conventional individualized physiotherapy, body-awareness therapy, and the FM. Seventy-eight participants with nonspecific musculoskeletal pain disorders were separated into three groups. Each group participated in 20 treatment sessions over 6 weeks. All groups showed improvement on measures of pain, depression, and anxiety with good carryover and no difference between groups in 6-month and 1-year follow-ups. Although no significant differences were found between groups, effect-size analysis suggested that the FM and body-awareness therapy were more effective than conventional therapy.

Lundqvist, Zetterlund, and Richter (2014) studied 61 participants with visual impairment and nonspecific chronic neck and shoulder pain. Participants were randomly assigned to either a

Feldenkrais intervention group or a no-treatment/control group. Those assigned to the Feldenkrais group participated in 2-hr weekly sessions of FI and ATM for 12 weeks. Sessions included time for reflection and discussion. The FM group showed significant improvements on a visual analog scale (VAS) that assessed pain and the Visual, Musculoskeletal, and Balance Complaints Questionnaire compared with controls at the postintervention and 1-year follow-up. In this study, the control group reported that pain increased in the follow-ups, leading the authors to conclude that if pain problems were addressed early, they would not build up. In addition, it was noteworthy that people with visual impairments responded well to the process of the FM intervention.

Paolucci et al. (2017) conducted a study with 53 individuals with CLBP comparing outcomes on pain measures using VAS and the McGill Pain Questionnaire and measured function and quality of life using the Waddell Disability Index and the SF-36 Health Survey. They also used the Multidimensional Assessment of Interoceptive Awareness Questionnaire (see Mehling, 2020) to assess body awareness. Participants were randomly assigned to back school or a Feldenkrais group. There were equivalent significant improvements in both groups with respect to pain, disability, and body awareness at end of treatment and at the 3-month follow-up. The authors concluded that the FM was equally effective as back school as an intervention for CLBP.

Finally, in his dissertation research, Sobie (2019, unpublished) extended the work of Paolucci et al. (2017) in addressing CLBP. He conducted an RCT study with 30 participants, comparing the FM with back school but modifying each slightly. The FM was combined with Virtual Reality Bones, which included skeletal models and density imagery, avatars, vestibular-system description, and self-touching techniques to emphasize the importance visualizing the skeleton as a key to body-schema enrichment. The back school comprised core stabilization biofeedback (CSB) and motor-control exercises, each accompanied by an educational component. Both CSB and motor-control exercises have been shown to improve CLBP individually and combined and are the current accepted physical-medicine standard for initial noninvasive treatment of CLBP. There was a progression of intervention elements, with individuals in each group participating in 12 sessions over 8 weeks. The goal of the CSB/CME group was to learn the core-stabilization process by progressively mastering core activation, followed by stabilization, and then dynamic stabilization. The overall goal for the Virtual Reality Bones/FM group was “reconstituting an improved perceptual awareness for ‘coming to know’ one’s own existing background body schema—as a whole—and improving upon its functional expression in terms of sensory acuity and motor dexterity” (Sobie, 2019, p. 252) notably not increasing strength and range of motion or reducing pain. All participants were assessed at baseline and 2 weeks, 4 weeks, and 8 weeks after the end of the intervention using four validated clinical instruments: VAS, disability, self-rated individualized functional assessment, and a measure of core endurance evaluating a combined score of flexor/extensor and lateral endurance and looking at a ratio of activity of flexors to extensors (F:E). While both groups improved their scores in all areas, the FM group made significantly greater improvement in the measures of pain, disability, and function. Although both groups improved endurance scores, there was no difference between groups on this measure. In addition, when comparing the F:E ratio scores, the FM group’s F:E score significantly decreased to a score close to 1.0 at 8 weeks while the CSB/CME score remained above 10. A score of <1.5 indicates a more coordinated and integrated use of trunk muscles. This suggests that individuals in the FM group learned to better coordinate or activate their trunk musculature, which led to decreased pain, reduced disability, and increased function.

Taken together, these studies suggest that the FM may be an excellent intervention for a variety of chronic pain syndromes that achieves its outcome not by breaking down the body to its constituent parts or identifying problematic tissues and stretching and strengthening them but by raising individuals’ level of awareness of their body as a functioning whole and improving its coordinated functioning through a series of movement lessons.

Research on Mechanisms of Action (or Internal Processes of Action)

Advocates of the FM claim that changes in patterns of movement coordination are a result of a process of learning. What are the implications? What experimental evidence is there for this claim?

Does the FM Involve Motor Learning?

Connors, Galea, Said, and Remedios (2010) addressed the question of whether ATM is a motor-learning process by qualitatively analyzing verbal cues given in the presentation of a set of ATM lessons. They looked for descriptive elements in the verbal presentation of the lessons that could be coded as themes in a motor-learning process. The most common themes were for variability of practice and repetition. (Repetitions of a specific movement are generally done in the spirit of exploration, with variable extent, speed, and sensory focus, noting interactions with other areas of the body, pain or stiffness, or fatigue. The goal is not greater range of motion or strength but the idea of taking a movement pattern from the level of being impossible to possible to easy, and then to elegant.) Next most common were cues to look for intrinsic feedback. There were very few cues for knowledge of results and none for knowledge of performance. In ATM lessons, students are not given feedback about whether they have moved their body properly, or well, or exactly how to move to enact the instructions. Judgment for that remains internal. Next, most were cues to look for points of, and a sense of, stability, both static and dynamic. Cues were also given to individuals to help them explore different movements and to try to sense different aspects of body image, including the experience of moving their hips, pelvis, low back, head, neck, and arms. Based on this qualitative study, the ATM process is clearly structured as a motor-learning process as it contains the classic elements of repetition, variability of practice, and feedback that is almost exclusively intrinsic in this case. These elements are known to facilitate transfer of learning (Magill & Anderson, 2017; Dhawale, Smith, & Olveczky, 2017).

The use of intrinsic feedback has been shown to be especially valuable to learning, as discussed by Vereijken and Whiting (1990) in a study of the acquisition of a novel coordination pattern—movements on a ski-simulator machine by nonskiers—via discovery learning. Corbetta, DiMercurio, Wiener, Connell, and Clark (2018) have confirmed the effectiveness of the exploratory learning process in their study of infant skill acquisition. It is for this reason that FM practitioners do not tell their students what movements they should do, although they may be able to do those movements well already, but let the end form of the movement emerge from an exploratory process.

Stephens, Pendergast, Roller, and Weiskittle (2005) documented significant improvements in performance of a supine-to-standing task in a group of seniors compared with a control group that continued normal daily activities. Outcomes were measured using a video movement-analysis technique developed by Kluzik, Fetters, and Coryell (1990). The ATM group performed the standing movement both faster and with fewer movement segments, indicating better motor-control coordination than at baseline and compared with controls. In accompanying qualitative questions, experimental participants reported that both walking and getting up from the floor felt easier. The SF-36 Mental Health and Vitality scores were also improved compared with the control group. In this study the experimental group participated in 10 ATM lessons during a 2-day period. Lessons were conducted in supine, side lying, sitting in a chair, or standing positions. None of these lessons involved transitioning from the floor positions to a standing position. The authors did not incorporate retention or transfer tests to assess learning, so they were not able to assess learning. This is true also for an RCT study by Stephens, Davidson, DeRosa, Kriz, and Saltzman (2006) that documented significantly improved hamstring length in a group of students who worked with three ATM lessons compared with controls who continued their usual stretching routines. The experimental group worked with multiple ATM variations for up to 15 min four or five times a week for 4 weeks. Retention or transfer test performance was not assessed, so caution is warranted relative to attributing changes in performance to learning. However, based on informal follow-up with participants, those authors found that many in the ATM group were still able to bend to touch the floor with knees straight years later, a skill that they did not previously have, without intervening practice (personal communication).

Sobie (2019) collected data on outcomes serially, at baseline and at 2 weeks, 4 weeks, and 8 weeks in his study of people with CLBP described earlier, so his research design was closer to a conventional motor-learning design. Results showed a steady improvement over the course of the study compared with the CSB/CME group despite notable improvements in the latter. Although there was no retention assessment to confirm learning, the 8-week assessment scores continued to improve in the FM group while the CSB/CME group remained stable. This is suggestive of retention or continued learning in the FM group.

As an initial attempt to answer the question of what people are learning, Stephens et al. (1999) conducted a study with people with multiple sclerosis, using both qualitative and quantitative measures. Four participants engaged in 10 weekly ATM lessons. Several themes emerged from their subjective feedback: (a) increased awareness of aspects of their movements including sense of center of gravity and pressure, position of their limbs, size and speed of movements, and breathing; (b) decrease in stiffness; (c) improvement in balance and control of movement in daily activities; (d) awareness of having more energy and making less effort to do things; (e) recognition that they could change their movement patterns to improve movement such as making steps larger or smaller; and (f) an improved mental outlook. While all participants reported improved mobility, balance, and control, specific measures of floor transfer and walking indicated that some people increased their speed, displacement, and/or stability in those activities (while others decreased their performance), creating wide variability in the objective data. One of the participants who experienced much improvement (but who was still considered disabled at the end of the study) was so empowered by her experience that she went on a Hawaiian vacation with her husband—a trip they had been postponing for years. It seems that different people learn different things from the same lessons. They learn something, perhaps unexpected, that they needed to learn to improve their function.

Unanswered Questions

Many questions on the mechanisms that underlie the benefits of the FM remain to be answered. What is the role of attention in the process? What about autonomic regulation? What is the role of effort? How is body image affected?

How Is Focus of Attention Used? First, it must be noted that the FM is not a performance or competitive activity, although people who study it may be performers. Generally, it is accepted in the motor control and learning literature that motor performance and learning are facilitated by adopting an external focus of attention during goal-directed activities. The benefits of an external focus have been shown for many different types of tasks including balance (see Wulf, 2013 and Wulf and Lewthwaite, 2016 for reviews). This is perhaps not surprising since one does not hit a baseball with one's arms or hips (as Manny Ramirez famously said, "See the ball, hit the ball"), and vision is one of the key systems responsible for not just tracking the ball but also for maintaining balance. This is not to say that the hips and arms are not important for hitting a baseball or that one's internal sense of center of gravity relative to the base of support is not important for balance. This may seem to suggest that the benefits of an external focus of attention are at odds with the benefits associated with attending to one's own movements and sensations during an FM ATM or FI lesson. Mattes (2016) suggested that this conflict of attentional focus may be unfounded. We find that there are at least four reasons that the findings are not necessarily at odds with each other. These reasons are briefly outlined following.

First, as noted by Russell (2020), FM lessons are not goal-directed. A student does not attempt to achieve a particular objective; rather, he or she playfully explores the sensations that arise during the execution of novel movements in novel positions. Consequently, the interference with automated behaviors that has been reported as a consequence of an internal focus of attention during goal-directed activities (e.g., Wulf, McNevin, & Shea, 2001) simply has no basis for occurring. The movements in the lesson are neither automated nor goal-directed. Second, the effects of an FM lesson on performance of an already-learned skill are typically secondary and indirect. In other words, a golfer's swing might improve not because she worked on her swing during a lesson but because she discovered a new way of coordinating the movements of the spine and arms during the lesson, which was subsequently integrated into many existing movement patterns (see the discussion of the topological conjecture in Russell, 2020, for how this might work). Stated otherwise, the golfer was able to swing differently, but not by attempting to learn to swing differently. Third, there is a growing literature suggesting that expert performers flexibly shift back and forth between an internal and an external focus of attention to optimize performance, depending on their immediate objective (e.g., Toner and Moran, 2015). For example, a performer might adopt an external focus of attention during the execution of a skill in a competitive situation but might use internal and external foci of attention when attempting to modify a habitual but maladaptive or suboptimal pattern of coordination when learning a new technique, or when relearning aspects of technique after a return from injury.

Finally, it is relevant here to consider a study by Mehling et al. (2013) that compared a large group of people with a history of chronic pain to a group of mind–body practitioners, many of whom were Feldenkrais practitioners, on Mehling's Multidimensional Assessment of Interoceptive Awareness. They found that the mind–body practitioners consistently scored much higher on the scales for not distracting, not worrying, attention regulation, self-regulation, emotional awareness, trusting, and body listening. The researchers concluded that the ability to focus internally on the body and the pain might contribute to an ability to modulate the pain. Many Feldenkrais practitioners began their training process with a search to end the chronic pain they were experiencing. The skill of being able to enter the pain experience rather than distract from, ignore, or avoid it may be an important aspect of the success of the FM with chronic pain, and it may actually be a component in elite athletic performance. For example, Mehling et al.'s findings are reminiscent of the findings from a classic study of elite marathon runners by Morgan and Pollock (1977), which have been replicated many times. Morgan and Pollock found that elite runners were much more likely to use associative rather than dissociative strategies during a race. They paid close attention to bodily sensations during running, they adjusted pace based on this sensory information, and they constantly focused on running in a relaxed manner. Clearly, then, internal-focus strategies are adaptive in some competitive performance situations, particularly when discomfort or pain are involved.

What About Autonomic Regulation? The Role of Stress and Anxiety. The FM is intended to be low stress, low anxiety, and with no judgment to produce the best learning environment to foster autonomic regulation. One of the oldest principles of motor learning is the concept of the inverted-U curve (Schmidt & Lee, 2011) for arousal and performance or learning. The idea is that some arousal is needed to learn and perform well but that with too much the performer will experience a decay of learning or performance. Since stress and anxiety are subjective, this is hard to precisely quantify. There is evidence (Hordacre, Immink, Ridding, & Hillier, 2016 as an example) that stress improves learning, retention, and performance of a skill over a short time scale. There is also evidence that stress contributes to the regression of performance of a learned skill (Schmidt & Lee, 2011). This may suggest an explanation of a frequently observed phenomenon related to Feldenkrais practice, that the effects of a lesson occasionally go away as a person goes back out into the process of his or her normal, stressful life.

There have been many anecdotal reports of reduction of stress and anxiety after Feldenkrais work. The first published report of this was by Johnson, Frederick, Kaufman, and Mountjoy (1999) in a study of 20 people with multiple sclerosis randomly assigned to experimental and control groups in a crossover design. The experimental groups received one FI lesson per week for 8 weeks. The authors reported significant reduction in perceived anxiety in the experimental groups. Smith, Kolt, and McConville (2001) worked with 26 people with CLBP and looked at outcome measures of anxiety and pain. They found a significant reduction in the affective dimension of pain but not sensory or evaluative dimensions compared with a no-treatment control group. However, their intervention was a single 30-min ATM lesson. They followed up this study with longer exposure to ATM lessons. Kolt and McConville (2000) reported a significant reduction of anxiety after four ATM lessons over 2 weeks, and Kerr, Kotynia, and Kolt (2002) found a significant reduction of state anxiety after a single ATM lesson and an even larger response of anxiety reduction at the end of 10 weekly ATM lessons. This research included people who had participated in their previous study. Thus, experienced participants seemed to have carryover from their first experience and made greater changes than the "new" people in the study. This research supports the idea that state anxiety may be reduced on a longer-term basis. This is in line with Mehling et al.'s (2013) findings suggesting a higher level of self-regulation in their mind–body group.

What Is the Role of Effort?. In Feldenkrais lessons, the importance of reducing effort to a minimum is noted over and over again (see the description of what is referred to as the Weber-Fechner-Henneman movement-optimization cycle in Russell, 2020). This cycle relies on the initial reduction of effort in order to enhance the sensory discrimination of small differences followed by the recruitment of small before larger muscles for an action. In a recent study of trunk-muscle recruitment, Rowley et al. (2019) found that participants with a history of LBP exhibited reduced trunk coupling or increased dissociated patterns of movement between the trunk and the pelvis. The essential element relating to pain was the ratio of deep to superficial muscle activation. A higher ratio of deep to superficial (small fibers to larger fibers) muscle activation was associated with a healthier back and less pain. This is a result that would be in line with expectations from Feldenkrais training and was part of the focus of instruction in the study by Sobie (2019).

How Is Body Image Affected?. Feldenkrais (1972) wrote in *Awareness Through Movement* that self-image consists of movements, sensations, feelings, and thoughts and that each one of these components will be present in any action. He considered this completeness vital for health. As has been stated already, cues directing attention to body image are a central part of the practice and teaching of ATM. We take for granted that a developed body image or schema makes for better motor learning. But how do we develop a good body image/schema? Instruction in the FM makes an effort to do this, as is clear from the emphasis of Sobie (2019) incorporating many sensory and perceptual elements involving the anatomy of the student's/patient's body and the ATM descriptions of Connors et al. (2010). The results from Stephens et al. (1999) also suggested that a "good" body image may be something different for each person. But what do we know about the success of efforts to make actual body-image changes?

The first FM research study investigating this question was conducted by Elgelid (1999) for his master's thesis. He worked with four students who performed twice-weekly ATM sessions for 6 weeks—a mix of ATM and one-on-one tutoring, or all one-on-one tutoring. The Semantic Differentiation Scale was used as an outcome measure. Elgelid reported that students who participated in ATM had greater and more lasting improvements in self-image than those who did not. More recently Stephens, Batson, Deutsch, and McAndrew (2018) conducted a preliminary study of the effects of ATM on people with chronic stroke-related disabilities. Ten participants participated in three 1.5-hr ATM classes per week for 6 weeks. There was no control group. The outcome measures were tests of balance, and mobility and movement imagery ability (MIQ; Hall & Pongrac, 1983) was also included. There were significant improvements in balance and in several timed movement measures, but interestingly and surprisingly the MIQ scores also improved significantly on both visual and kinesthetic scales, as well as the cumulative MIQ score. More surprising was a significant positive correlation between the increased MIQ scores and improved balance scores. This raises the possibility that the imagery of body movement is an important component of improving balance and mobility. The possibility of this conclusion is supported by work by Assaiante, Barlaam, Cignetti, and Vaugoyeau (2014), who examined the development of body schema through childhood and adolescence. They reviewed a neurosensory approach to the development of body schema, which they discuss as central to the maturation of motor control.

Bitter, Hillier, and Civetta (2011) studied the effects of a single ATM lesson on dexterity. The lesson focused on light finger-touch movements within the hand to bring attention to the relationships of the fingers and different parts of the hand kinesthetically. Outcome measures were the Purdue Pegboard Test and other measures including perceived ease of movement. Experimental participants made significant improvements in dexterity in their dominant but not their nondominant hand. In addition, they reported greater ease of movement in a writing task.

Finally, Schmalzl and Kerr (2016) have called for brain-function-level research on movement-based embodied contemplative practices such as ATM, suggesting that these approaches have a great deal to offer therapeutically and in the understanding of brain function. The only study of this type using the FM was conducted by Verrel, Almagor, Schumann, Lindenberger, and Kuhn (2015), who used fMRI (functional magnetic resonance imaging) to examine the effects in the cortex of a simple manipulative procedure called artificial ground (AG). During an AG FI lesson, slight pressure is applied upward through the foot into the leg and body. Researchers compared this AG condition with a control condition in which the board was placed against the bottom of the foot and simply held without any projection of pressure into the body through the foot. Both conditions were applied while the participants were in the fMRI machine. Verrel et al. found that in the AG condition there was an increase in activity in higher-order motor cortices compared with the expected more localized sensory cortical responses in the control condition. This preliminary study shows how actions during FI can affect areas of the brain in different and specific, intended ways. Clearly, more work needs to be done in this interesting and important area.

Thoughts on Future Research

The FM is rich with complexity and potential for improving people's lives in a variety of ways. To get the recognition the FM deserves, more research needs to be done. We are off to a good start with this. Limitations have been the skills of practitioners to do research, our ability to engage other established researchers from their already busy agendas, and financial support. Here we will list a number of possible research areas, jumping off from cited studies, and invite researchers everywhere to follow up on them. We will be glad to collaborate on any projects. There are, of course, many other possibilities—this is just the tip of the iceberg.

1. Verrel et al. (2015). Replicate this study and follow up with functional assessments to look at functional effects of this procedure.
2. Stephens et al. (2018). Replicate the effect on movement imagery in a larger RCT with a similar clinical group and an active control group.
3. Stephens et al. (2006). Repeat the hamstring-lengthening study using a formal motor-learning design. Look at how long practice sessions (duration) need to be and how long a training period (Frequency × Time) needs to be to produce the reported effect. Add functional assessments and long-term retention measures.
4. Rowley et al. (2019). Repeat this study of people with CLBP. Look at the question of whether the coupling of deep and superficial muscles seen in CLBP can be altered using ATM to the more healthy, pain-free pattern as suggested by Sobie (2019). There are three hypothetical outcomes. (a) Pain will decrease. (b) Demonstrate improvement in coupling. (c) Functional measures show improvement: easier bending, faster walking, improved sense of well-being.
5. Use video motion-capture and force-plate technology to assess the changes in joint motion and force distribution that occur in standing and walking after the ATM (twisting with crossed legs) lesson described in the paper by Russell, 2020.
6. Assess how body image/schema changes over a series of ATM lessons in elderly people and how this correlates with function.
7. Take a more extensive look at internal versus external focus of attention. Where is internal more effective? Is it possible to track the process of attentional changes in early development in childhood? What about during performance by high-level athletes?
8. Autonomic regulation: Continue studying effects of the FM in this area, perhaps especially in people with posttraumatic stress disorder, people with dementia, and young people who are drug users. There is some beginning work suggesting effectiveness in these areas.

Conclusion

There have now been 30+ RCTs investigating the FM in diverse populations and with varied outcome measures. As Hillier and Worley (2015) concluded, there is reasonably strong and consistent evidence that the FM confers benefits, particularly at the functional level (such as balance), and potentially symptom reduction in terms of reduced pain and increased comfort. Considering some of the outcomes measured, it is reasonable to conclude that the benefits are mediated by learning processes that harness embodied awareness, attention, and self-image.

It is critically important that the FM be evaluated for effectiveness using the best-practice approach of an RCT, preferably with an active control group. Some may view the RCT approach as reductionist, but it is clear that in the current climate of evidence-based practice, such rigor is required to confirm that the effects reported are indeed true effects, at the same time understanding that different people may respond in different ways to the same lesson. It is also important to expand on the research beginning to grapple with questions of how the FM may work. This may be productive for both understanding brain function and improving applications of the FM. This is not to negate phenomenological and qualitative investigations, which illuminate and give voice to the lived experience of the FM—these answer different questions.

References

Arumugam, S., Ayyadurai, P., Perumal, S., Janani, G., Dhillon, S., & Thiagarajan, K.A. (2020). Rowing injuries in elite athletes: A review of incidence with risk factors and the role of biomechanics in its management. *Indian Journal of Orthopaedics, 54*(3), 246–255. PubMed ID: 32399142 doi:10.1007/s43465-020-00044-3

Assaiante, C., Barlaam, F., Cignetti, F., & Vaugoyeau, M. (2014). Body schema building during childhood and adolescence: A neurosensory approach. *Neurophysiologie Clinique, 44*(1), 3–12. PubMed ID: 24502900 doi:10.1016/j.neucli.2013.10.125

Barnes, D.E., Mehling, W., Wu, E., Beristianos, M., Yaffe, K., Skultety, K., … Chesney, M.A. (2015). Preventing loss of independence through exercise (PLIE): A pilot clinical trial in older adults with dementia. *PLoS ONE, 10*(2), e0113367. PubMed ID: 25671576 doi:10.1371/journal.pone.0113367

Bearman, D., & Shafarman, S. (1999). The Feldenkrais method in the treatment of chronic pain. *American Journal of Pain Management, 9,* 22–27.

Bitter, F., Hillier, S., & Civetta, L. (2011). Change in dexterity with sensory awareness training: A randomized controlled trial. *Perceptual Motor Skills, 112*(3), 783–798. PubMed ID: 21853767 doi:10.2466/15.22.PMS.112.3.783-798

Brummer, M., Walach, H., & Schmidt, S. (2018). Feldenkrais 'functional integration' increases body contact surface in the supine position: A randomized-controlled experimental study. *Frontiers in Psychology, 9,* 2023. PubMed ID: 30405500 doi:10.3389/fpsyg.2018.02023

Causby, R.S., McDonnell, M.N., Reed, L., & Hillier, S.L. (2016). A randomised controlled trial of sensory awareness training and additional motor practice for learning scalpel skills in podiatry students. *BMC Medical Education, 16*(1), 309. PubMed ID: 27919251 doi:10.1186/s12909-016-0817-8

Connors, K.A., Galea, M.P., Said, C.M., & Remedios, L.J. (2010). Feldenkrais method balance classes are based on principles of motor learning and postural control retraining: A qualitative research study. *Physiotherapy, 96*(4), 324–336. PubMed ID: 21056168 doi:10.1016/j.physio.2010.01.004

Cook, S.B., LaRoche, D.P., Swartz, E.E., Hammond, P.R., & King, M.A. (2014). A novel sensorimotor movement and walking intervention to improve balance and gait in women. *Complementary Therapies in Clinical Practice, 20*(4), 311–316. PubMed ID: 25456024 doi:10.1016/j.ctcp.2014.09.003

Corbetta, D., DiMercurio, A., Wiener, R.F., Connell, J.P., & Clark, M. (2018). How perception and action fosters exploration and selection in infant skill acquisition. In J.M. Plumert (Ed.), *Advances in child development and behavior: Studying the perception–action system as a model system for understanding development* (Vol. 55, pp. 1–29). Elsevier Academic Press.

Cote, J.N. (2012). A critical review of physical factors and functional characteristics that may explain a sex/gender difference in work-related neck/shoulder disorders. *Ergonomics, 55*(2), 173–182. PubMed ID: 21846285 doi:10.1080/00140139.2011.586061

Dhawale, A.K., Smith, M.A., & Olveczky, B.P. (2017). Role of variability in motor learning. *Annual Review of Neuroscience, 40*(1), 479–498. PubMed ID: 28489490 doi:10.1146/annurev-neuro-072116-031548

Elgelid, H.S. (1999). *Feldenkrais and body image* [Master's thesis]. University of Central Arkansas, Conway, AK.

Ernst, E., & Canter, P.H. (2005). The Feldenkrais method—A systematic review of randomised clinical trials. *Physikalische Medizin Rehabilitationsmedizin Kurortmedizin, 15*(3), 151–156. doi:10.1055/s-2004-834763

Feldenkrais, M. (1972). *Awareness through movement*. New York, NY: Harper & Row.

Hall, C., & Pongrac, A. (1983). *Movement imagery questionnaire*. London, ON, Canada: University of Western Ontario.

Hillier, S., & Worley, A. (2015). The effectiveness of the Feldenkrais method: A systematic review of the evidence. *Evidence-Based Complementary and Alternative Medicine, 2015,* 752160. PubMed ID: 25949266 doi:10.1155/2015/752160

Hordacre, B., Immink, M.A., Ridding, M.C., & Hillier, S. (2016). Perceptual–motor learning benefits from increased stress and anxiety. *Human Movement Science, 49,* 36–46. PubMed ID: 27309494 doi:10.1016/j.humov.2016.06.002

Ives, J.C., & Shelley, G.A. (1998). The Feldenkrais method in rehabilitation: A review. *Work, 11*(1), 75–90. PubMed ID: 24441485 doi:10.3233/WOR-1998-11109

Johnson, S.K., Frederick, J., Kaufman, M., & Mountjoy, B. (1999). A controlled investigation of bodywork in multiple sclerosis. *Journal of Alternative and Complementary Medicine, 5*(3), 237–243. PubMed ID: 10381247 doi:10.1089/acm.1999.5.237

Kerr, G A., Kotynia, F., & Kolt, G.S. (2002). Feldenkrais awareness through movement and state anxiety. *Journal of Bodywork and Movement Therapies, 6*(2), 102–107. doi:10.1054/jbmt.2001.0274

Kibler, W.B., Wilkes, T., & Sciascia, A. (2013). Mechanics and pathomechanics of the overhead athlete. *Clinics in Sports Medicine, 32*(4), 637–651. PubMed ID: 24079426 doi:10.1016/j.csm.2013.07.003

Klintberg, I.H., Cools, A.M.J., Holmgren, T.M., Holzhausen, A.-C.G., Johansson, K., Maenhout, A.G., … Ginn, K. (2015). Consensus for physiotherapy for shoulder pain. *International Orthopaedics, 39*(4), 715–720. PubMed ID: 25548127 doi:10.1007/s00264-014-2639-9

Kluzik, J., Fetters, L., & Coryell, J. (1990). Quantification of control: A preliminary study of the effects of neurodevelopmental training on children with spastic cerebral palsy. *Physical Therapy, 70*(2), 65–76. PubMed ID: 2296614 doi:10.1093/ptj/70.2.65

Kolt, G.S., & McConville, J.C. (2000). Effects of a Feldenkrais Awareness Through Movement program on state anxiety. *Journal of Bodywork and Movement Therapies, 4*(3), 216–220. doi:10.1054/jbmt.2000.0179

Lake, B. (1985). Acute back pain: Treatment by the application of Feldenkrais principles. *Australian Family Physician, 14*(11), 1175–1178. PubMed ID: 2935132

Lefevre-Coulau, M.-M., Nguyen, C., Palazzo, C., Srour, F., Paris, G., Vuillemin, V., … Roren, A. (2018). Kinematic patterns in normal and degenerative shoulders. Part II: Review of 3-D scapular kinematic patterns in patients with shoulder pain and clinical implications. *Annals of Physical and Rehabilitation Medicine, 61*(1), 46–53. PubMed ID: 28987866 doi:10.1016/j.rehab.2017.09.002

Lundblad, I., Elert, J., & Gerdle, B. (1999). Randomized controlled trial of physiotherapy and Feldenkrais interventions in female workers with neck/shoulder complaints. *Journal of Occupational Rehabilitation, 9*(3), 179–194. doi:10.1023/A:1021301801292

Lundqvist, L-O., Zetterlund, C., & Richter, H.O. (2014). Effects of Feldenkrais method on chronic neck/scapular pain in People with visual impairment: A randomized controlled trial with one-year follow-up. *Archives of Physical Medicine and Rehabilitation, 95*(9), 1656–1661. PubMed ID: 24907640 doi:10.1016/j.apmr.2014.05.013

Magill, R.A., & Anderson, D.I. (2017). *Motor learning and control: Concepts and applications* (11th ed.). New York, NY: McGraw-Hill.

Malmgren-Olsen, E-B., Armelius, B-A., & Armelius, K. (2001). A comparative outcome study of body awareness therapy, Feldenkrais, and conventional physiotherapy for patients with nonspecific musculoskeletal disorders: Changes in psychological symptoms, pain, and self-image. *Physiotherapy Theory and Practice, 17*(2), 77–95. doi:10.1080/095939801750334167

Manchikanti, L., & Hirsh, J.A. (2015). What can be done about the increasing prevalence of low back pain and associated comorbid factors? *Pain Management, 5*(3), 149–152. PubMed ID: 25971636 doi:10.2217/pmt.15.10

Mattes, J. (2016). Attentional focus in motor learning, the Feldenkrais method, and mindful movement. *Perceptual and Motor Skills, 123*(1), 258–276. PubMed ID: 27502242 doi:10.1177/0031512516661275

Mehling, W.E. (2020). If it all comes down to bodily awareness, how do we know? Assessing bodily awareness. *Kinesiology Review, 9*(3). doi:10.1123/KR.2020-0021

Mehling, W.E., Daubenmier, J., Price, C.J., Acree, M., Bartmess, E., & Stewart, A.L. (2013). Self-reported interoceptive awareness in primary care patients with past or current low back pain. *Journal of Pain Research, 6,* 403–418. PubMed ID: 23766657 doi:10.2147/JPR.S42418

Morgan, W.P., & Pollock, M.L. (1977). Psychologic characterization of the elite distance runner. *Annals of the New York Academy of*

Sciences, 301(1), 382–403. PubMed ID: 270929 doi:10.1111/j.1749-6632.1977.tb38215.x

Myers, L.K. (2016). Application of neuroplasticity theory through the use of the Feldenkrais method(®) with a runner with scoliosis and hip and lumbar pain: A case report. *Journal of Bodywork and Movement Therapies, 20*(2), 300–309. PubMed ID: 27210847 doi:10.1016/j.jbmt.2015.06.003

Nijs, J., Meeus, M., Cagnie, B., Roussel, N.A., Dolphens, M., Van Oosterwijck, J., … Danneels, L. (2014). A modern neuroscience approach to chronic spinal pain: Combining pain neuroscience education with cognition-targeted motor control training. *Physical Therapy, 94*(5), 730–738. PubMed ID: 24481595 doi:10.2522/ptj.20130258

Palmer C.F. (2017). Feldenkrais movement lessons improve older adults' awareness, comfort, and function. *Gerontology and Geriatric Medicine, 3,* 2333721417724014. PubMed ID: 28840179 doi:10.1177/2333721417724014

Paolucci, T., Attanasi, C., Cecchini, W., Marazzi, A., Capobianco, S., & Santilli, V. (2018). Chronic low back pain and postural rehabilitation exercise: A literature review. *Journal of Pain Research, 12,* 95–107. PubMed ID: 30588084 doi:10.2147/JPR.S171729

Paolucci, T., Zangrando, F., Iosa, M., De Angelis, S., Marzoli, C., Piccinini, G., … Saraseni, V.M. (2017). Improved interoceptive awareness in chronic low back pain: A comparison of back school and Feldenkrais method. *Disability and Rehabilitation, 39*(10), 994–1001. PubMed ID: 27215948 doi:10.1080/09638288.2016.1175035

Parenmark, G., Engvall, B., & Malmkvist, A.-K. (1988). Ergonomic on-the-job training of assembly workers: Arm-neck-shoulder complaints drastically reduced amongst beginners. *Applied Ergonomics, 19*(2), 143–146. PubMed ID: 15676656 doi:10.1016/0003-6870(88)90008-7

Pugh, J.D., & Williams, A.M. (2014). Feldenkrais method empowers adults with chronic back pain. *Holistic Nursing Practice, 28*(3), 171–183. PubMed ID: 24722612 doi:10.1097/HNP.0000000000000026

Quaseem, A., Wilt, T.J., McLean, R.M., & Forciea, M.A. (2017). Noninvasive treatments for acute, subacute, and chronic low back pain: A clinical practice guideline from the American College of Physicians. *Annals of Internal Medicine, 166*(7), 514–530. PubMed ID: 28192789 doi:10.7326/M16-2367

Rowley, K.M., Smith, J.A., & Kulig, K. (2019). Reduced trunk coupling in persons with recurrent low back pain is associated with greater deep-to-superficial trunk muscle activation ratios during the balance-dexterity task. *Journal of Orthopaedic & Sports Physical Therapy, 49*(12), 887–898. PubMed ID: 31092122 doi:10.2519/jospt.2019.8756

Russell, R. (2020). Perspectives on the Feldenkrais method. *Kinesiology Review, 9*(3). doi:10.1123/KR.2020-0028

Salamh, P., & Lewis, J. (2020). It's time to put special tests for rotator cuff-related shoulder pain out to pasture. *Journal of Orthopaedic & Sports Physical Therapy, 50*(5), 222–225. PubMed ID: 32272031 doi:10.2519/jospt.2020.0606

Schmalzl, L., & Kerr, C.E. (2016). Editorial: Neural mechanisms underlying movement-based embodied contemplative practices. *Frontiers in Human Neuroscience, 10,* 169. PubMed ID: 27199700 doi:10.3389/fnhum.2016.00169

Schmidt, R.A., & Lee, T.D. (2011). *Motor control and learning: A behavioral emphasis* (5th ed.). Champaign, IL: Human Kinetics.

Smith, A.L., Kolt, G.S., & McConville, J.C. (2001). The effect of Feldenkrais method on pain and anxiety in people experiencing chronic low back pain. *New Zealand Journal of Physiotherapy, 29*(1), 1–9.

Sobie, T. (2019). *Body schema acuity training and Feldenkrais movements compared to core stabilization biofeedback and motor control exercises: Comparative effects on chronic non-specific low back pain in an outpatient clinical setting: A randomized controlled comparative efficacy study* [Doctoral dissertation]. Saybrook University, Oakland, CA.

Stephens, J., Batson, G., Deutsch, J.E., & McAndrew, P. (2018, July). *Awareness through movement improves movement imagery and balance in adults post stroke: Preliminary findings*. Poster presented at Harvard Movement Conference: Brain Body Cognition, Boston MA.

Stephens, J., Call, S., Evans, K., Glass, M., Gould, C., & Lowe, J. (1999). Responses to ten Feldenkrais Awareness Through Movement lessons by four women with multiple sclerosis: Improved quality of life. *Physical Therapy Case Reports, 2*(2), 58–69.

Stephens, J., Davidson, J., DeRosa, J., Kriz, M., & Saltzman, N. (2006). Lengthening the hamstring muscles without stretching using "awareness through movement." *Physical Therapy, 86*(12), 1641–1650. PubMed ID: 17033041 doi:10.2522/ptj.20040208

Stephens, J., Pendergast, C., Roller, B.A., & Weiskittle, R.S. (2005). Learning to improve mobility and quality of life in a well elderly population: The benefits of awareness through movement. *Feldenkrais Research Journal, 2,* 17. http://iffresearchjournal.org/volume/2/stephens

Teixera-Machado, L., Araújo, F.M., Cunha, F.A., Menezes, M., Menezes, T., & DeSantana, J.M. (2015). Feldenkrais method exercise improves quality of life in individuals with Parkinson's disease: A controlled, randomized clinical trial. *Alternative Therapies in Health and Medicine, 21*(1), 8–14. PubMed ID: 25599428

Toner, J., & Moran, A. (2015). Enhancing performance proficiency at the expert level: Considering the role of 'somasthetic awareness.' *Psychology of Sport and Exercise, 16*(Part 1), 110–117. doi:10.1016/j.psychsport.2014.07.006

Torres-Unda, J., Polo, V., Dunabeitia, I., Bidaurrazaga-Letona, I., Garcia-Gill, M., Rodriguez-Larrad, A., … Irazusta, J. (2017). The Feldenkrais method improves functioning and body balance in people with intellectual disability in supported employment: A randomized clinical trial. *Research in Developmental Disabilities, 70,* 104–112. PubMed ID: 28923375 doi:10.1016/j.ridd.2017.08.012

Ulmann, G. (2016). Case report: Outcome of Feldenkrais movements on self-reported cognitive decline in older adults. *Advances in Mind–Body Medicine, 30*(2), 19–23. PubMed ID: 27250213

Vereijken, B., & Whiting, H.T.A. (1990). In defence of discovery learning. *Canadian Journal of Sport Sciences, 15*(2), 99–106. PubMed ID: 2383829

Verrel, J., Almagor, E., Schumann, F., Lindenberger, U., & Kuhn, S. (2015). Changes in neural resting state activity in primary and higher-order motor areas induced by a short sensorimotor intervention based on the Feldenkrais method. *Frontiers in Human Neurosciences, 9,* 232. PubMed ID: 25972804 doi:10.3389/fnhum.2015.00232

Wu, E., Barnes, D.E., Ackerman, S.L., Lee, J., Chesney, M., & Mehling, W.E. (2015). Preventing loss of independence through exercise (PLIE): Qualitative analysis of a clinical trial in older adults with dementia. *Aging & Mental Health, 19*(4), 353–362. PubMed ID: 25022459 doi:10.1080/13607863.2014.935290

Wulf, G. (2013), Attentional focus and motor learning: A review of 15 years. *International Review of Sport and Exercise Psychology, 6*(1), 77–104. doi:10.1080/1750984X.2012.723728

Wulf, G., & Lewthwaite, R. (2016). Optimizing performance through intrinsic motivation and attention for learning: The OPTIMAL theory of motor learning. *Psychonomic Bulletin & Review, 23*(5), 1382–1414. PubMed ID: 26833314 doi:10.3758/s13423-015-0999-9

Wulf, G., McNevin, N.H., & Shea, C.H. (2001). The automaticity of complex motor skill learning as a function of attentional focus. *Quarterly Journal of Experimental Psychology Section A, Human Experimental Psychology, 54*(4), 1143–1154. PubMed ID: 11765737 doi:10.1080/713756012