Science Catches Up – Alexander Technique Principles & 21st Century Research

I have spent the last 18 years trying to understand Alexander technique from a scientific perspective, using insights from AT to inspire testable hypotheses, and testing those hypotheses. It is now over 100 years since FM Alexander published his first book, and scientists are finally asking questions where insights from Alexander technique can make a difference. Before examining some relevant modern research, let's review a few key aspects of how science works.

Peer Review and Replication

No matter how careful and objective scientists try to be, we all need outside perspectives on our work. Peer review and replication are two of the most important parts of the scientific process. Here's how it works:

After I write an article, I submit it to a peer-reviewed journal for consideration. The editor glances at it and decides whether to reject it immediately or send it out for review. It often takes months to gather reviews from willing volunteers with suitable expertise. A paper could be accepted or rejected at this stage; more typically, reviewers will request specific changes, which might include things like 'run another study' or 're-analyze the data.' Multiple rounds of review are common. Most published researchers also serve as reviewers, and most of us try to provide constructive feedback that will lead to a better final published paper. Any paper not published in a peer-reviewed scientific journal has not passed this essential test.[1–3]

Even with peer review, a single study is never enough. No matter how careful the research, it is still inevitable, based on the laws of statistics, that many published results are wrong.[4] Therefore, findings need to be replicated before they can be trusted: other researchers must run the same or a similar study to confirm or not confirm the original findings. It takes many peer-reviewed studies before an approach is recognised by mainstream scientific organisations like the National Institutes of Health (NIH). Some perspective: In August 2018, I entered 'Alexander technique' into a pubmed.gov search and got 96 hits. Then I entered 'tai chi' and got 1279 hits – that's over 13 times as many peer-reviewed studies. NIH just recently started promoting tai chi on their website[5]… so don't hold your breath for AT to show up there anytime soon.

Progress and Change

The overall goal of science is to keep expanding the boundaries of knowledge. Influential studies provide a foundation for subsequent research to build on *incrementally*. Alexander's work was not developed within this framework, which creates challenges for scientists who want to study it. For instance, Frank Pierce Jones did interesting studies that did not influence the science of human motor function or behaviour. Jones' 1965 study showed that people stand up from a chair differently with an Alexander teacher's hands-on guidance than without that guidance[6], but the study is almost never cited in the 'sit-to-stand' literature. Why? Jones conducted his studies 20 years before anybody was studying how people get out of chairs. Nobody was interested in the problem to which he was offering a solution! [i] Fifty-five years later, there is a large body of literature about how people get out of chairs. (Entering 'Sit to stand' at scholar.google.com yields over 27,000 results.) Only recently has enough groundwork been laid to create a context where questions about Alexander's ideas make sense[7].

Scientific models change over time, evolving as new tools are developed and new evidence is acquired. Alexander wrote his books about a hundred years ago, when psychology and neuroscience were in their infancy, and scientists were just figuring out how synapses and reflexes work. Science has come a long way since then, and our field has not kept up.

One thing we need to move past is our tendency to describe our work in terms of reflexes. Reflexes are inborn, mostly spinal, and nearly instantaneous. They occur as automatic, involuntary responses to stimuli. Scientists like simple, elegant theories that can explain a lot of phenomena. If you could successfully explain all behaviour in terms of reflexes, that would be a great victory. However, reflexes can't account for things like learning or the involvement of higher levels of the nervous system, nor can they explain complex, voluntary, or self-generated movements.[8]

Reflexes were the 'hot new thing' when Alexander was first developing his work. A hundred years later, people still use reflexes to explain the AT in ways that are unsupported by current science. For instance, when Magnus discovered the tonic neck reflex, the AT community got excited. But this is a tiny, inconsistent effect in neurologically healthy adults.[9] Turn your head to the right, and notice that your arms do NOT go flying off in different directions. Nor would it be useful to you if they did!

Furthermore, some AT teachers talk about an 'anti-gravity reflex.' However, current science says there is no such thing. We maintain balance in the face of gravity using continuous information from many sources: the vestibular system, vision, muscles in the ankle, pressure sensors in the bottoms of the feet - all this information is combined with flexible weighting according to context. It's much more complicated, flexible, and interesting behaviour than a reflex would allow.[10]

Relevant fields of study

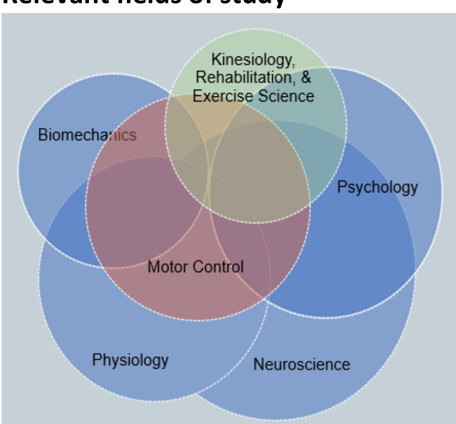

Fig. 1 These overlapping scientific disciplines are where you can find the most AT-relevant research. Basic fields are in blue, applied fields in green, and inter-disciplinary fields in red.

If AT principles are true, they should be discoverable by researchers outside of AT. However, they may be described differently and dispersed among different scientific fields, including *psychology* (since AT cultivates specific intentions), *physiology* (since our intentions must be embodied by muscles, bones, etc.), *neuroscience* (which bridges the mental and physiological realms), and *biomechanics* (since the physical material of our bodies obeys natural laws of physics). The scientific field that covers the overlap of all these areas is *motor control*; the associated applied research areas are *exercise science, kinesiology,* and *rehabilitation science*. These are the fields (shown in Figure 1) where you will find research about intention, inhibition, stress, mindfulness, coordination, posture, balance, and movement.

The remainder of this article is organised according to the chart below. The left column lists AT concepts, the middle column lists related scientific concepts, and the right column contains an informal assessment of the amount of published literature relevant to the AT concept.

Alexander Technique Concept	Related Scientific Concepts	Evidence?
Positions of Mechanical Advantage	Ergonomics & Biomechanics	Lots
Use Affects Function	Dynamic Postural Tone; Deep vs. Surface Muscles	Some
Direction	Intention; Motor Imagery	Some
Primary Control	Neck Physiology	A Little
Inhibition	Inhibitory Control	Lots
End-Gaining	Motor Preparation	Almost None
Faulty Sensory Appreciation	Sensation vs. Perception; Body Schema, Proprioception	Lots
The Force of Habit	Satisficing vs. Optimizing	Some
Unity of the Self	Embodied Cognition; Parkinson’s disease; Neural Circuitry	Some

Mechanical Advantage

The principle that some positions are more mechanically advantageous than others is closely related to *ergonomics*, which is basically the smart application of biomechanics to work life. We often look askance at ergonomics, because we have seen terrible products marketed as ‘ergonomic.’ Ergonomics has one of the same problems Alexander technique has, which is that nobody controls who can use the term. Nonetheless, mainstream biomechanics-based ergonomics recommendations are consistent with some of what we teach[11]. That’s because the principles are true – they exist beyond us. In fact, they are based on **Isaac Newton’s laws of mechanics.**

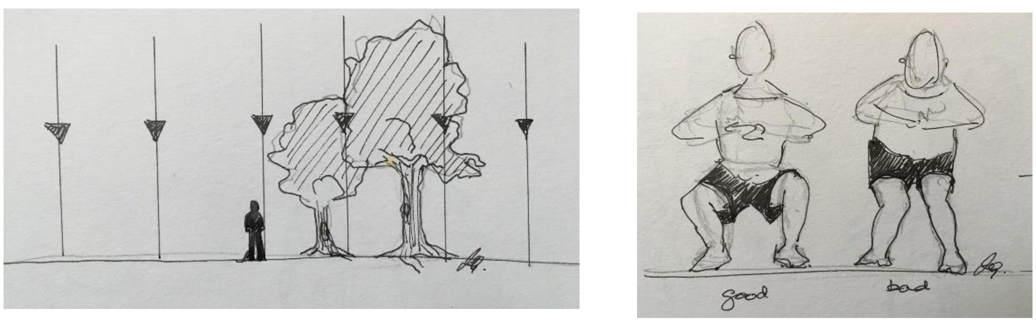

Fig. 2. Left: gravity is a field force. Right: aligning joints is mechanically advantageous. (Artist: Jenny Quick)

Newton’s third law states that for every action, there is an equal and opposite reaction. Gravity is acting on us constantly. If we are not actively falling, it is because of upward forces that are exactly matched to gravity. However, gravity is a field force, acting on our whole body, while the upward forces are contact forces, transmitted through our bones. Therefore, putting the bones directly between our mass and the ground allows the forces to equalize with minimum effort (Figure 2). Taking this further, weight is a measure of force. The effective weight of a body part is a function of its horizontal distance from skeletal support. Therefore, when the mass of the body is not aligned over the bony support, the muscles and connective tissues are subject to more stress[12].

Alexander teachers don’t focus exclusively on alignment, but we do try to get people to spend more of their time in mechanically advantageous positions. If you look up ‘head back and down’ in a scientific database, you will not find anything. However, if you search for ‘forward head posture’ there is quite a bit of research. In this case, ‘forward’ means excessively forward in space relative to the spine. You can also search for ‘hyperkyphosis,’ which means excessive curvature in the upper spine. Both body shapes are associated with poor health outcomes, including neck pain[13], jaw pain[14], carpal tunnel syndrome[15], headache[16], and increased fall risk and mortality[17,18]. Thus, there is strong support overall for the idea of mechanical advantage.

Use Affects Function

One cornerstone of AT is the idea that one's neuromuscular state has widespread effects on other aspects of one's state, including posture and movement. Tim Cacciatore studies *use* by assessing the dynamic regulation of postural tone, defined as the baseline muscular activity that supports the body against gravity and underlies readiness to move[19]. Some of this research is done with a custom device called Twister, which holds a participant's head or upper body lightly in place while the floor rotates at one degree/second and torque sensors record resistance to that rotation. Subjects are asked simply to stand and allow themselves to be twisted. Dr. Cacciatore found that Alexander teachers were able to reduce their resistance more than control subjects, and that when people with back pain took a course of Alexander lessons, they became better at reducing their resistance[20]. The key result here is the association of better use with *more dynamically modifiable* postural tone[7].

Another area of science relevant to direction is the motor imagery literature. Motor imagery is internally simulating a movement without making any overt movement. In the brain, it is very similar to moving; it activates most of the same brain areas, it takes about the same amount of time, and it may be an important part of preparing to move. The concept is popular in coaching and training, as you can improve performance, tune reflexes, and even increase strength just by imagining movement. Motor imagery has been a topic of interest in neuroscience for a long time. Recently, the topic has been expanded beyond overt movement to include postural responses.

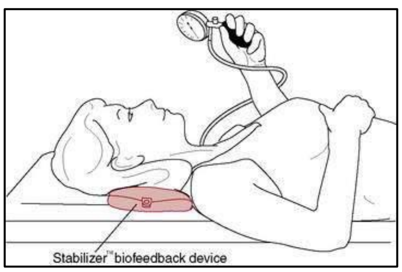

Fig. 3. Cranio-cervical flexion test[21].

Also relevant to the conversation about use and function is the idea that people over-use superficial muscles and under-use deep muscles for posture. Evidence comes from the cranio-cervical flexion test, shown in Figure 3[21]. Participants lie supine with an air pillow under their neck and tilt their heads forward in controlled amounts, registered by a pressure sensor. Researchers assess activation of the sternocleidomastoids (superficial neck muscles) using electromyography (EMG). Studies show that people with neck pain have high sternocleidomastoid activation during this task, and that training to perform the task with less sternocleidomastoid activation may reduce neck pain[22].

We recently published a pilot study testing the hypothesis that sternocleidomastoid activation and neck pain could be reduced by addressing overall use[23]. We recruited ten participants with chronic neck pain for an Alexander class that met twice a week for five weeks. We used a multiple baselines design to assess changes that were not due to our intervention. Before and after the class, we did several measurements, including the cranio-cervical flexion test. In addition to examining overall activation of the muscle, we looked at the power spectrum of the EMG signal.

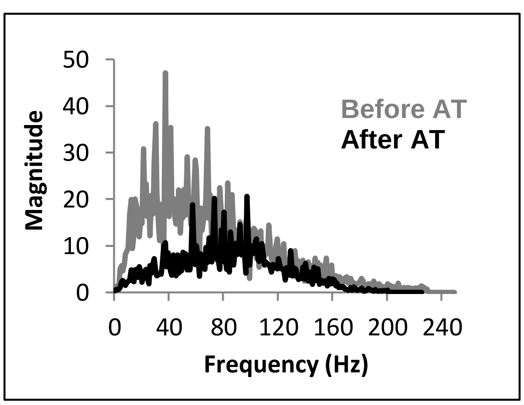

Fig. 4. Representative data from sternocleidomastoid muscle activity of a single subject performing the cranio-cervical flexion test, before and after AT classes[23].

In Figure 4, you can see the power spectrum from a single participant, from two trials of the cranio-cervical flexion test (before and after AT classes). This way of looking at EMG data shows the amount of a muscle's electrical impulses in different frequency ranges. Muscles fire more slowly when they are tired, so lower frequency indicates muscle fatigue. Notice that after AT classes, the overall magnitude of the signal decreased while the frequency increased. Our results suggest that before Alexander classes, participants were overusing their sternocleidomastoid muscles so that they were chronically fatigued, whereas after lessons, they were not overusing the muscles.

Direction

Having defined use & function as the influence of postural tone on physiological/motor outcomes, we can define direction as the psychomotor intentions that influence postural tone.[ii]

There are several ways that postural tone could affect motor outcomes. Insufficient tone could cause forward stooping and a lack of coordination between the limbs and the torso, leading to inefficient control. On the other hand, excessive tone might cause either a pulled back stance, as in an exaggerated soldier's posture, or a pulled forward stance, such as in Parkinson's disease. Either way, we would predict a loss of independence in the limbs and torso, leading to less effective psychomotor control.

An ongoing line of studies in my lab investigates whether giving explicit instructions about postural tone leads to consistent changes in postural control[24]. I started with Parkinson's patients because they have obvious deficits in postural tone: they tend to be very pulled down and rigid, and they often have difficulty turning. For this study, I gave three brief sets of contrasting instructions to 20 people with moderately severe Parkinson's disease. In the Effortful condition, I told them: 'Parkinson's makes your muscles weaker, so you need to work extra hard to activate the core muscles to pull yourself up.' In the Lighten Up condition, I told them: 'Parkinson's makes your muscles overactive, so you need to think about letting go of the muscles that are pulling you down.' In a third condition they were asked to stand relaxed, like it was the end of a long day and nobody was watching. All participants practiced and performed all three sets of instructions, in counterbalanced order.

The Lighten Up instruction led to the best motor outcomes in several tasks. In Twister, we found the lowest resistance in the Lighten Up condition and the highest resistance in the Effortful condition, suggesting that the Lighten Up instructions may improve mobility.

We assessed horizontal and vertical distance between markers on the ear and the shoulder (shown in Figure 5). In the Effortful condition, the head was pulled back without gaining height, leading to a shortened neck. This suggests that using muscular effort to correct one's posture may be counter-productive.

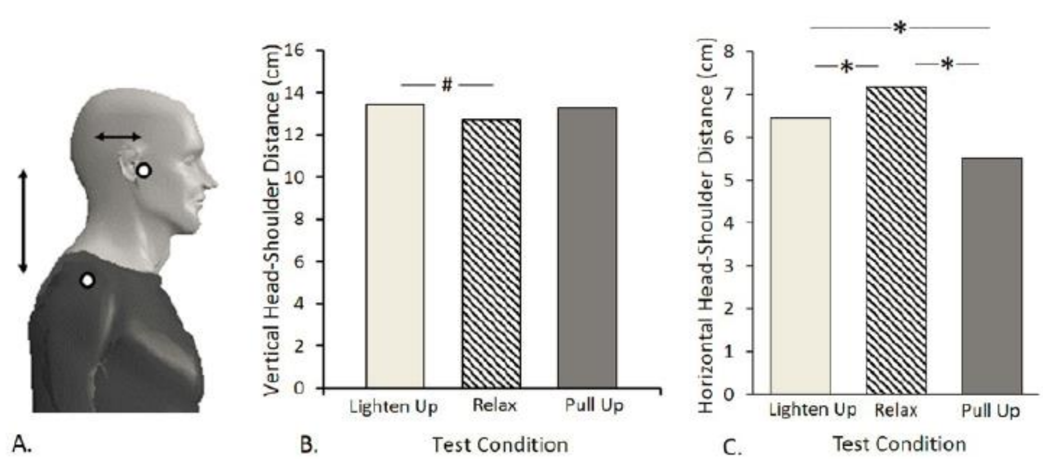

Fig. 5. Does giving explicit instructions about postural tone lead to consistent changes in upright posture? Results from a study with people living with Parkinson's diesease[24].

We assessed postural steadiness with an accelerometer attached to the waist during quiet stance. Sway amplitude was lowest in the Lighten Up condition, consistent with steadier balance.

Finally, we looked at step initiation, using a force platform. Lighten Up instructions led to the smoothest movement onset and the highest ratio of backward force to lateral force, suggesting improved efficiency. Overall, the Lighten Up instructions, which could be thought of as a simple version of directing, induced immediate changes in the motor system with positive outcomes.

Primary control

Primary control is challenging to explain scientifically, as it is inconsistently defined within AT literature and is often associated with out-of-date reflex models. Most definitions include a somewhat vague idea that the neck plays a special role in use and functioning. However, although existing evidence indicates that the neck is well-endowed with position sensors (muscle spindles)[25] and important for orientation[26], this does not seem sufficient to grant the neck singular status in our work.

Evidence for the importance of neck position to orientation comes from a study conducted by Molly Johnson, an AT teacher and neuroscientist. She had study participants stand in different postures, and she measured how steady they were. According to anatomical definitions, tilting your head forward is flexion, and tilting it backward is extension. The study found no difference between neutral and flexed neck positions, but when people tilted their heads back, balance was worse. This is an example where what you do with your head affects your overall condition.

One recent paper provides tantalizing evidence suggesting that how we use our neck muscles may have broad effects on the whole self[27]. The first and last authors, Ian and Alison Loram, are both Alexander teachers, and Ian runs a research lab in Manchester, England. The researchers provided violinists with ultrasound biofeedback images of their neck muscles. The violinists were given instructions to minimise the change in shape of those muscles while performing a range of tasks at the violin. The violinists able to use the biofeedback to minimise neck muscle activity, and the reduction in muscle activity led to cascading, uninstructed effects on the whole motor system, including reduced pressure on the violin chin rest, reduced forward movement of the shoulders, and reduced leg muscle activity (recorded with EMG). In addition, galvanic skin response (an indicator of sweatiness) was lower, suggesting that people were calmer.

Inhibition

In the context of psychology and neuroscience, *inhibitory control* refers to the ability to withhold or prevent a response. It is a key element of the 'executive functions' that regulate mental processes[28,29]. Inhibitory control can be further divided into reactive control (in which you suddenly need to prevent an already-planned action) and proactive control (in which you decide in advance to suppress a habitual response)[30]. Proactive control may be more relevant to Alexander technique.

Recent neuroscience indicates that inhibition and choice are closely linked. In fact, from a neural perspective, choosing a response and choosing not to respond are practically indistinguishable[31]. Both selecting a response and withholding a response rely heavily on the pre-supplemental motor area (in the frontal cortex) and the basal ganglia (in the middle of the brain), with differences in which specific cells fire when. Sometimes the processes are described as a race between excitatory commands and inhibitory signals, with a combination of global inhibition and focal disinhibition. At the neural level, it is very common for a pool of neurons to inhibit neurons that inhibit another pool of neurons, in order to allow an action to proceed. (Yes, the brain does process double negatives.)

To explore the relationship between inhibition and choice, I conducted a study of step initiation[32]. Note that before stepping, you need to shift your weight laterally to unweight the stepping foot. Sometimes, if you are in a hurry, you might shift your weight onto your stepping foot and then need to quickly correct. In this study, we presented a left or right visual cue and asked participants to step as quickly as possible with the foot that was on the same side as the light. Our primary measure was how often people made errors in the direction of the initial weight shift. We found that older people made these errors more often than young people.

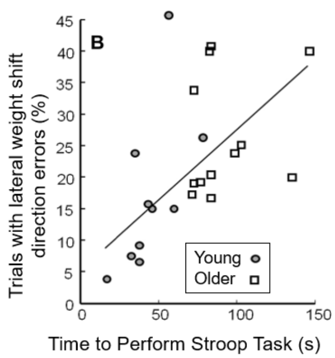

Fig. 6. Data showing a correlation between poor performance on the Stroop task (a measure of inhibitory control) and likelihood to initially select the wrong foot for stepping[32].

Our participants also performed the Stroop task, a classic measure of proactive inhibitory control. In the critical condition of the task, participants view colour words (red, blue, black, green, purple) written in ink colours that do not match the word. The task is to rapidly name the ink colours. This requires literate adults to inhibit a strong tendency to read the words, slowing performance. In our study, participants with the slowest Stroop times were also the most likely to shift their weight in the wrong direction before stepping (Figure 6). This suggests that failures of inhibitory control are related to failures in action planning and choice.

Evidence suggests that practicing mindfulness meditation may improve inhibitory control[33]. I strongly suspect that Alexander technique can, too. This hypothesis has not yet been tested.

End-gaining

Let's define end-gaining as the idea that over-focusing on a goal without attention to the means of attaining that goal causes problems. (I like this broad definition because it could include all kinds of non-motor magical thinking, like the 'law of attraction.') The field of motor control contains almost no research on end-gaining. [iii]

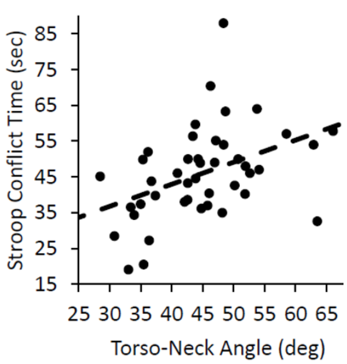

Fig. 7. Subjects who pushed their heads forward the farthest also displayed the poorest results in a test of inhibitory control[34].

A graduate student and I recently investigated the idea that focusing on a goal can cause people to interfere with head/neck coordination when initiating movement. At baseline, participants stood holding a tray. Later, they were asked to prepare to walk to place the tray on a shelf, with or without balancing a rolling item on the tray. Measuring their position three seconds before they took a first step toward the shelf, we found that participants pushed their necks forward when preparing to walk (relative to baseline), especially in the more difficult (rolling) condition. One might consider this as evidence for end-gaining. Interestingly, the subjects who pushed their heads forward the farthest were also the ones with the worst performance on a test of inhibitory control. (See figure 7). This suggests that failures of inhibitory control may contribute to end-gaining[34].

Faulty Sensory Appreciation

FM wrote about 'faulty sensory appreciation' or 'debauched kinesthesia.' These terms refer to the unreliability of our impressions, which is an important topic in psychology and neuroscience. However, we would do well to update our terminology.

A key distinction in the scientific literature is between sensation and perception[35]. (This is standard terminology; most psychology and neuroscience departments include a class called 'sensation and perception' in their catalogue.) *Sensation* is the raw signal as detected by the sensory organs – the eyes, ears, nose, tongue, and skin, as well as the vestibular organs in the inner ear, the proprioceptors embedded in muscles, and so on. *Perception* is the experience of vision, hearing, smelling, tasting, touching, balance, and kinesthesia (body position), informed by our understanding of the world and our expectations. (We say that perception is 'high-level' because it is sophisticated and complex, and because it relies on the cortex, which is considered a higher brain region.)

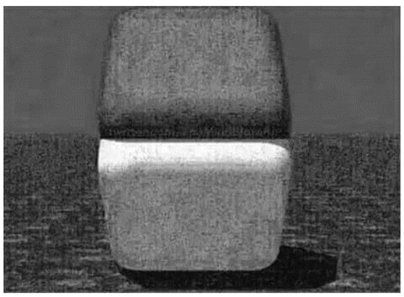

Fig. 8. A visual illusion reveals the disparity between raw sensation and habituated perception. The bottom shape appears lighter than the top, until you conceal the middle section between the two.

The distinction between sensation and perception is clearest in the context of visual illusions. For instance, in the image at left, the bottom shape looks lighter than the top shape. But if you cover up the middle of the image, you will cancel the illusion and see that the bottom and top shape are the same actual shade. The amounts of light hitting your retina are the same (sensation), but a lifetime's experience with light and shadow tells you that the shades are different (perception). Please don't make the mistake of thinking that we would be better off with only raw sensation. Sensation is often inherently ambiguous. We need high-level perception to make sense of information acquired in real life contexts.

We can make the same distinction with somatosensory information, using *proprioception* to indicate the raw sensory information coming in via muscle spindles and tendon organs, and *kinesthesia* for the high-level perception of where our body parts are in space and how we are moving[36].[iv] Importantly, kinesthesia requires combining sensory information with the *body schema*. Body Schema is an 'internal representation' or map of the body used to control movement and posture. Although we can bring it to awareness, it normally operates unconsciously, helping the brain to interpret proprioceptive inputs to generate kinesthesia. Body schema is built upon a lifetime's experience and can be altered. For instance, when you use a tool, your body schema expands to include the capabilities afforded by that tool[37,38].

Veridical means 'coinciding with reality,' so the opposite of debauched kinesthesia is veridical kinesthesia. Alexander technique might improve kinesthesia by influencing body schema. Proprioception, the low-level sensory information, remains just as incomplete and imperfect as ever, but the internal map of the body is more accurate, leading to more veridical kinesthesia. (This would be the case whether or not one teaches with an explicit focus on 'body mapping.') To my knowledge, this hypothesis has not yet been tested.

A related question is why we often feel lighter after an AT lesson. The answer is probably very straightforward. Weight is a multisensory perception based on the raw sensation of pressure on the bottom of your feet (if you are standing) or buttocks (if you are sitting), plus the sensations of compression in your joints and internal organs, plus the amount of muscular effort expended to resist gravity[39]. If you can learn to balance over your bones and pull down less so that you need less muscular effort to pull yourself up, that will be perceived as increased lightness. You don't need to invoke any mysterious 'anti-gravity reflexes.' When you don't pull yourself down so much, you won't feel so heavy.

The Force of Habit

When we talk about the force of habit, we mean (in part) that humans don't move optimally, but instead repeat motor patterns that have been previously evaluated as 'good enough.' Interestingly, there are a lot of motor control theories based on the idea that humans DO move optimally. Engineers have proposed theories based on sets of equations that minimise some cost, such as error, torque, or energy[40]. This makes sense if you are programming a robot, but it is probably not how humans operate. These approaches require pages of calculations for decisions that are probably planned at low levels of the nervous system. It's doubtful that the spinal cord performs multivariate calculus. Evidence suggests that rather than optimising, we satisfice - we draw on our memory of stored movement plans, mentally simulate a few to find a good one, tweak it a bit, and call it adequate[8,41]. The amount of fine tuning probably depends on how pressed we are for time, how important we think the action is, and how refined our internal simulation ability is. Movements made directly from memory with very little fine tuning could be said to be habitual.

My first published study illustrated this principle[42]. Participants moved a kitchen plunger from a static starting shelf to a target shelf at one of several heights. We observed that they grasped the plunger high when moving it to a low shelf, and low when moving it high, to maximise precision at the end location. However, when returning the plunger to its starting position, participants grasped at the same location they had just used, rather than maximising end-location precision. We argued that the return move relied on memory to reduce computational cost. Relying on habit makes sense when the movement (or posture) is actually good enough!

Unity of the Self

It may seem like a truism by now that the mind and body are connected, but there is still a lot of debate about what that means[43,44]. The field of study called embodied cognition investigates the idea that features of cognition are shaped by aspects of the body[45]. Some well-known studies in this field do not replicate[46]. However, others do. Many of the best-replicated studies use approach motivation as an outcome measure. For instance, in one study, participants had to exert upward or downward force on a table while watching a movie[47]. Afterwards, they were offered cookies while answering questions about the movies. Subjects who had been exerting upward force, thus engaging muscles typically used for flexing, or bringing things closer, ate three times as many cookies as subjects who had activated extensor muscles, typically used for pushing things away. Expect continued debate about the nature and importance of embodied cognition.

Neurological disorders provide another window into the unity of the self. Parkinson's disease is the second-most common neurodegenerative disease (after Alzheimer's). The main motor symptoms are slow movement, rigid muscles, stooped posture, and resting tremor. For many years, Parkinson's was considered to affect only the motor system. However, we now know that it also affects cognition – especially mood and executive function – and that the cognitive and motor symptoms are related. For instance, Parkinson's leads to increased dependence of action selection on recent history[48].

Freezing of gait, common in advanced stages of Parkinson's disease, causes intermittent difficulty walking; people who freeze may feel like their feet are stuck to the floor, and they often fall[49]. What is so interesting about this motor symptom is how tightly woven it is with cognition[50,51]. Freezing is associated with anxiety, with time pressure, and with transitions, such as starting, stopping, or turning a corner. In addition, we have found that people with freezing of gait have particular deficits in inhibitory control. It seems like they turn inhibition ON and then can't turn it OFF[52]. This interconnectedness of cognitive and motor symptoms suggests that cognition and motor control are deeply integrated in healthy functioning[53,54].

Let's end with the brain. Early conversations about the brain proposed that different parts control different functions: for instance, it was thought that thinking occurred in the cerebral cortex (the 'highest' level of the brain), and gait and balance were controlled by lower areas, such as brainstem and cerebellum. The idea of a mind/body hierarchy carried over to how we saw the brain. We now know it is not that simple. Modern neuroscientists instead consider the brain in terms of circuits[55].

Diffusion tensor imaging is a relatively new technique for tracing structural connections in the brain. We published a study showing that in people with Parkinson's disease, freezing of gait was associated with impoverished pathways between the frontal cortex and a brainstem area associated with control of postural tone[56]. I think it's very possible that Alexander technique could help build connectivity between cortical and subcortical brain regions; we are in conversation with researchers at a major neuroimaging centre to try to get such a study going. It takes a lot of time and money to do something like this, so check back with us in a few years.

In closing, I offer these thoughts. Science is a process, not just a body of knowledge. Chances are, whatever scientific principle you use to explain the work today will eventually be obsolete. The Alexander technique, too, is a process. FM Alexander was brilliant, but he was not perfect, and some of what you have been taught during your training is probably wrong. Bearing this in mind, please don't let your explanations or understandings of the work crystallize. Hold your ideas lightly. Be adaptive: steady in your skill and open to change.

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Endnotes

i. To find out if a publication or a researcher has been influential, you can go to scholar.google.com and enter the name of the article or the researcher. If a researcher is registered with google, you will see a list of all their peer-reviewed publications, with information about how many times each publication has been cited and an overall summary of their citations per year. Influential papers are those that are cited at least several times per year by other researchers.

ii. Direction may be a means of strengthening the connections between the prefrontal cortex, which deals with changing circumstances, and brainstem, which sets tone.

iii. There is a substantial body of evidence showing that across a range of tasks and situations, focusing on a desired outcome yields *better* results than attending to one's own body. Of course, these studies all use objectively assessed task performance (rather than, for instance, later development of pain) as their outcome measures, and their instructed ways of focusing on the body are relatively crude. Still, it's a body of literature worth considering. [35]

iv. Unfortunately, scientists have not yet come to a consensus on this terminology. Some researchers use the terms interchangeably. However, the conceptual distinction is important.

Acknowledgements: This paper benefited from feedback by Monika Gross, Molly Johnson, Patrick Johnson, Nanette Wash, and Andrew Putnam McCann.

Bio: Rajal Cohen graduated from the Virginia School for Alexander Technique in 1997. In 2000, drawn by a desire to understand *how* the Alexander technique works (and inspired by meeting Tim Cacciatore at an AT meeting), she decided to pursue graduate training. She earned her Ph.D. in psychology at Penn State with a minor in kinesiology, then completed four years of postdoctoral training in neurology at Oregon Health & Science University, focusing on the relations between cognitive and motor symptoms in Parkinson's disease.

Dr. Cohen is an Associate Professor in the Department of Psychology and Communication at the University of Idaho, where she teaches classes on behavioral research methods, ergonomics & biomechanics, motor control, and neuroscience; and conducts research on the role of cognition in human movement and posture. She holds affiliate faculty positions in the Department of Biological Science and at Washington State University. Her Mind in Movement Laboratory houses a 3-d motion-capture camera system, inertial sensors, EMG (to listen to muscles) EEG (to listen to the brain), and the newly-renovated Twister.

Dr. Cohen accepts graduate student applications every fall. Most accepted students receive teaching assistantships with free tuition and a modest stipend.