CURRENT SCIENTIFIC RESEARCH & MODELS FOR THE ALEXANDER TECHNIQUE

Science Symposium
18th May 2020

Ian Loram
Professor of Neuromuscular Control of Human Movement, Cognitive Motor Function Research Group, Research Centre for Musculoskeletal Science & Sports Medicine, Department of Life Sciences, Manchester Metropolitan University, UK
Overview

How can the Alexander Technique be explained & validated in contemporary scientific terms so that it is credible to a clinical-scientific audience?
I am a scientist motivated by my experience of the Alexander Technique

Qualified Teacher of the Alexander Technique, Professional Association of Alexander Teachers, 1989-1997

PhD, University of Birmingham, 2002

Leverhulme Early Research Fellow, University of Birmingham, 2004-6

Professorship, Manchester Metropolitan University
Credibility & adoption of AT requires theory & practice to become objective & validated

Current Situation - Subjective Practice

- Value of AT is private
- Knowledge, judgement, expertise of the Alexander teacher is invisible
- Diagnosis of a pupil’s use is unmeasured & unvalidated
- Teaching methodology unvalidated
- Many variations & interpretations of AT
Credibility & adoption of AT requires theory & practice to become objective & validated

- Concepts
  - Defined

- Mechanisms of AT
  - Explained in scientific terminology
  - Validated using objective data

- Process of learning
  - Defined
  - Observable
  - Data in public domain

- Cochrane reports
Current research

Technology for measuring muscle action & movement
https://royalsocietypublishing.org/doi/full/10.1098/rsos.191011

Rules governing neuromuscular control
https://www.nature.com/articles/s41598-020-61896-1
https://journals.physiology.org/doi/full/10.1152/jn.00875.2011

Motor decision making in activity (Intermittent Control paradigm)
https://journals.lww.com/acsm-essr/fulltext/2014/07000/Does_the_Motor_System_Need_Intermittent_Control_.5.aspx

Neurological conditions & rehabilitation

ORCID: http://orcid.org/0000-0001-8125-6320
https://scholar.google.com/citations?hl=en&user=dIVchq8AAAAJ&view_op=list_works&sortby=pubdate
What is the AT about?

- Psycho-physical re-education on a general basis

- Constructive conscious control of the individual
Contributions to the Alexander Technique community currently in the public domain

- Textbook explanation of sensorimotor control

- Evidence of mechanism of AT
  - Supplementary Material: [https://ieeexplore.ieee.org/abstract/document/7792725/media#media](https://ieeexplore.ieee.org/abstract/document/7792725/media#media)

- Exposition of how specific symptoms can arise from a general mechanism (MSc Thesis):
  - Loram A., (2013). *Chronic Profession-limiting problems in musicians: Underlying mechanisms & neuroplastic routes to recovery.* MSc thesis, Division of Surgery & Interventional Science, University College London, UK. [http://dx.doi.org/10.17613/M6CN7R](http://dx.doi.org/10.17613/M6CN7R)

- Talk: explaining AT to medical-scientific audience
  - [https://hcommons.org/deposits/objects/hc:17010/datalocationsto/CONTENT/content](https://hcommons.org/deposits/objects/hc:17010/datalocationsto/CONTENT/content)
Textbook chapter: explanation of sensorimotor control

Postural control & sensorimotor integration


http://e-space.mmu.ac.uk/600519/
Textbook chapter shows the key processes of sensorimotor control.

The AT should be explainable within these terms:

- perceptual, executive, motor, & biomechanical processes
- acting concurrently
- related within a closed-loop feedback system

---

Psycho-physical unity refers to …

- perceptual, executive, motor, & biomechanical processes
- acting concurrently
- related within a closed-loop feedback system

Use is.....

... the evolution through time of the states of the psycho-physical system

These states exist within the perceptual, executive, motor, & biomechanical processes

- Sensory analysis (perception)
  - Sensations
  - Percepts
  - Concepts

Selection (basal ganglia)
- Goals
- Actions
- Movements & sub-movements
- Constraints

- Motor generation
  - Activity of all neurons & muscles

- Movement biomechanics
  - Forces
  - Configuration (position) of body segments
Use implies ownership of . . . .

. . . . the evolution through time of the states of the psycho-physical system

What causes my movements & responses to the stimuli around me?

- Biological decision-making
  - Generation of multiple possibilities
  - Selection + reinforcement & consolidation of useful choices

- Selection (basal ganglia)
  - Inhibition
  - Facilitation

- Highly facilitated responses
  - Fast, involuntary, bypass basal ganglia, habitual “reflexive”, environmental causality, (thick arrow)

- Inhibition
  - Delay, time to consider selection, slow, voluntary, intentional causality (thin arrows)
Sensory appreciation is ...

...sensory analysis
- perception
- interpretation of sensations
- unconscious & conscious
- biased by prior experience associated with effort, tension, stiffness, sympathetic arousal, success/failure, safety/danger & happiness/fear
- perceive difference from expectation
- sensory & sensory association cortex

- input
  - internal & external sensation,
  - prior experience,
  - memory,
  - current state ...

- output
  - multiple possibilities for action

Direction is ...  

... selection  
- of goal, actions to achieve selected goal, of movements & sub-movements to achieve a selected action  
- of constraints  
- mainly inhibition of alternative goals-actions-movements  
- unconscious & conscious  
- limited persistence, refreshed repeatedly  
- basal ganglia & frontal cortex...

- input  
  - action possibilities highlighted in frontal cortex  
  - concept

- output  
  - all instructions & parameters needed by the motor system to generate the muscle forces & movement  
  - intention

The motor system knows how to organise muscle activity

Motor generation
- Translates intention goal + constraints into muscle activity
- Organised
- Proximal to distal segments
- Related to configuration
- Unconscious
- Motor cortex, brain stem, spinal cord

Movement biomechanics
- Translates muscle activity into muscle forces & movement

Practical example to consolidate understanding

- Sit or stand quietly with hands at your side
- Follow the instructions as I say them (don’t lag behind)
- Applying goals and constraints in initiation and execution of movement was an exercise in direction
- Including constraints within direction is easy
- Proximal constraints have wider influence than distal constraints
- Constraints minimising effort have different effects to constraints limiting position
Using ultrasound to observe neck muscles
Using ultrasound to observe neck muscles
Experiment to determine the effect of minimising unnecessary activity in the neck muscles

**Proactive Selective Inhibition Targeted at the Neck Muscles:**
This Proximal Constraint Facilitates Learning & Regulates Global Control


IEEE Transactions on Neural Systems & Rehabilitation Engineering 25: 357-369. [http://dx.doi.org/10.1109/TNSRE.2016.2641024](http://dx.doi.org/10.1109/TNSRE.2016.2641024)
Proactive, selective inhibition targeted at the neck muscles

Selective inhibition
- to prevent muscular action incongruent with the task,
  while concurrently allowing functionally relevant muscle action

Proactive
- use of environmental information to prepare the forthcoming inhibitory action
What is the effect of minimising unnecessary action in the neck muscles?

Methods

- Raising arms
- Picking up object
- Picking up & playing the violin
Instruction & feedback ensured participants minimised change in neck muscles while performing the task.

B Normal

E Neck Regulation
- “Minimise shape change”
Main Result

Association between

• **Reduced neck muscle change**
  • Direct (instruction + feedback)

• **Whole body changes (head, trunk, limbs)**
  • Indirect (not instructed, not planned)
  • Reduced complex, whole-body task-irrelevant movement patterns
Complex, whole-body, task-irrelevant movement reduced by minimising change in neck muscles (C-E)
The effect of proactive selective inhibition targeted at the neck muscles

Indirect uninstructed effects

- Reduced complex involuntary, whole-body task-irrelevant movement patterns
- **Improved balance** - reduced cost of movement
- Facilitated new, task-relevant movement

Fig 6 PQR
A causal mechanism is demonstrated

- Proactive selective inhibition targeted at neck muscles has an indirect causal effect on whole-body movement.
- Regulatory
- Selective inhibition of neck muscles imposes a constraint on whole-body motor plan.
- To be consistent with the constraint, the brain has to generate something new.
- Forces a change in automated sensorimotor control.
- Proximal location ensures whole-body influence.
- Criterion: inhibition of unnecessary action: ensures reduced cost while facilitating task-relevant variation & learning.
Misuse is.....

…the concurrent, related operation of misconception, habitual selection, unnecessary muscle activity organised according to an observed pattern (“pulling down”) of unnecessary biomechanical tension & stiffness:

- Sensory analysis (perception)
  - inaccurate
  - biased by prior irrelevant experience associated with excess effort, tension, stiffness, sympathetic arousal, failure, danger & fear

- Selection (direction)
  - highly facilitated
  - habitual-reflex
  - environmentally driven
  - lack of proactive, selective inhibition

- Motor generation
  - unnecessary muscle activity organised according to a common observable pattern
    - unnecessary stiffening the neck, pulling head back & down, shortening & narrowing the back, stiffening the legs, pulling feet onto the ground, narrowing upper arms, stiffening arms & hands
    - consequence of our structure of linked segments & proximal-distal rules of neuromuscular organisation

- Movement biomechanics
  - unnecessary tension, stiffness
  - impaired performance
Misuse grows through time: proposed explanation

- Consequences of (mis)conception & (habitual) selection
  - Performance
  - Cost

- How do we adapt?
  - Correct & learn = good use
  - Reinforce misconception = misuse

- Consequences subject to feedback
  - Misconception amplified by feedback
  - Mathematically positive (i.e. "bad")
  - Symptoms grow until system breaks at its weakest point

- A general mechanism
  - Any misconception amplified by feedback
  - Why? Unable to change concept or selection
  - All symptoms

Wind-up
Positive Feedback
Until destruction at the weakest point


How does the Alexander Technique work?

- All causes of misuse solved by the same method
- Proactive, selective inhibition targeted at the neck muscles
- breaks the circuit
- regulates whole-body control & facilitates learning

Loram A., (2013). *Chronic Profession-limiting problems in musicians: Underlying mechanisms & neuroplastic routes to recovery*. MSc thesis, Division of Surgery & Interventional Science, University College London, UK. [http://dx.doi.org/10.17613/M6CN7R](http://dx.doi.org/10.17613/M6CN7R)

Summary: This presentation proposes explanation of the AT consistent with modern sensorimotor control

- Concepts:
  - Psychophysical unity, use, misuse, sensory appreciation, direction, inhibition

- Mechanisms
  - Evidence of effect of proactive, selective inhibition targeted at …..the neck muscles
  - Proposed a general mechanism of re-education for improving use

Thank you for listening!

Sources


Supplementary Material: [https://ieeexplore.ieee.org/abstract/document/7792725/media#media](https://ieeexplore.ieee.org/abstract/document/7792725/media#media)

Loram A., (2013). *Chronic Profession-limiting problems in musicians: Underlying mechanisms & neuroplastic routes to recovery*. MSc thesis, Division of Surgery & Interventional Science, University College London, UK. [http://dx.doi.org/10.17613/M6CN7R](http://dx.doi.org/10.17613/M6CN7R)

Summary: This presentation proposes explanation of the AT consistent with modern sensorimotor control

• Concepts:
  • Psychophysical unity, use, misuse, sensory appreciation, direction, inhibition

• Mechanisms
  • Evidence of effect of proactive, selective inhibition targeted at …..the neck muscles
  • Proposed a general mechanism of re-education for improving use

• Thank you for listening!

Sources


Supplementary Material: https://ieeexplore.ieee.org/abstract/document/7792725/media
