

No 2 MORE ABOUT MUSCLES AND GRAVITY

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1. The last time I was talking about gravity, weight, muscles and standing on our own two feet, otherwise known as bipedalism.
2. In talking about the muscles, I said the ones we were interested in for our present purposes are called the skeletal muscles. These are the ones which are attached to the bones of the skeleton.
3. There about six hundred of these muscles. They are the little motors which enable us to do things. There are three ways in which they are controlled.
4. The most familiar way is voluntarily. We decide to do something and we do it. I am going to take a step or bend my arm or whatever and I do it. These kind of deliberate or voluntary actions, are under the control of the cerebral cortex, the thinking part of the brain.
5. This is why these muscles are often called the voluntary muscles. We decide to do something and the necessary muscles come into action and do it. This distinguishes them from the involuntary or autonomic muscles in our intestines, heart and elsewhere.
6. It is our control over the voluntary muscles that enables us to do all kinds of complicated things like typing, dancing or rioting. But normally we do not exercise our control over these muscles on an individual muscle basis.
7. I decide to bite off a bit of chocolate and I do it. I do not instruct my jaw muscles, the masseters, to do the job; I just decide to take the bite. But there are times when we can and do influence muscles directly. I can deliberately tighten my biceps, for example.
8. More generally, our voluntarily control is over the details of how the action is carried out by the muscles. Alexander called this ability to get the muscles to do what we want in the way we want "*conscious control*".
9. The fact that we are able to perform voluntary actions gives us plenty of freedom to do things in different ways. But it also gives us plenty of opportunity to use ourselves badly. This may be a result of ignorance, carelessness or just because we want to do so.

10. Deliberately slouching to look like a rebel, pulling the tummy in to look thinner than we are, exercising through the pain barrier, or whatever, we can spot the various ways in which the people around us deliberate misuse themselves all the time.
11. The second way in which skeletal muscles are controlled is reflexly. Reflexes are innate or inborn programs or patterns of performing certain actions. They happen automatically but they use the voluntary muscles. A well-known example is the patellar reflex which happens when the doctor gives us a tap below the kneecap and the lower leg kicks outwards.
12. An enormous amount of our muscular activity happens in a reflex way and this was an area of human and animal behaviour which interested Sir Charles Sherrington and Rudolph Magnus.
13. In order to establish just how much of our postural activity is governed by reflexes, Magnus conducted hundreds of experiments on animals in which the cortex had been removed or disabled. That meant no thinking was possible so there could be no conscious control over the muscles. Whatever these animals did had to be reflex.
14. He found that, to a quite amazing extent, the characteristic ways that animals hold and use themselves when they are standing, walking, running and other basic actions are controlled reflexly from the lower brain, the brainstem.
15. The control systems for these reflexes are present from birth and they come into action when the animal has reached a sufficient stage of physical development to put them into practice. This age varies between animals – young horses can stand and walk a couple of hours after birth whereas human babies need the best part of a year before they are ready.
16. The details of how the various postural reflexes work are different between different animals. The basic way a person uses themselves, for example, is different from the way a rabbit or a kangaroo does.
17. Since these postural reflexes are part of our genetic inheritance we can assume that when they represent the most efficient and undamaging ways of using our muscles in that particular action. In evolutionary terms minimising the amount of energy required for standing has the double advantage of

making for an efficient use of the available energy or food resources as well reducing the wear and tear on our weight-bearing joints.

18. But at the same time, an important feature of these reflexes is that they are easily overridden by our conscious control. When you are being tested for the patellar reflex, the doctor always asks you to relax. He is essentially asking you to allow the reflex to happen. You can refuse to allow it to happen if you wish.
19. We now come to the third way in which the skeletal muscles are controlled. This by means of what we call our habits.
20. Habits arise as a result of the way in which we deliberately use ourselves. After a certain amount of repetition or practice, many of these deliberate actions turn into habits.
21. When a deliberate action has become a habit, we do it without thinking about it. In that sense it is very similar to a reflex but instead of being innate, it is learned. We are born with our reflexes but we learn our bad habits.
22. Babies and young people learn their habits mainly by copying others. Infants start to mimic those around them from a very early age. Later we do it deliberately and often call it training.
23. The fact that an action has become a habit means that we are unaware of the way in which we do it. Because of this we are often doing something quite differently from what we think we are doing. People tend to be quite surprised when they learn that they walk around with their head pulled back and down, for example
24. One of the consequences of having a habitual way of doing something is that it feels like the right way. This means that every other way of doing it feels wrong, even when the other way happens to be the right way. This is what Alexander called *faulty sensory awareness*.
25. The other consequence of having a bad habit is that though we can correct it, as soon as we stop thinking about it, we revert to the habit.
26. So, to summarise, when we are doing things, or, as we say, using ourselves, in any particular way, instructions can be coming to our muscles in three different ways: conscious control, reflexes, and habits. It is the interaction between

these three control systems which determines how our skeletal muscles actually behave from moment to moment.

27. For each individual person, there are so many possible variables and interactions between these control systems that every one of us acquires our own particular way of using ourselves. This can be quite distinctive so that we are often able to recognise people by their way of walking or standing.
28. I now want to turn from the question of muscle control to what the muscles are used for. Obviously they can be used for millions of things but we are particularly interested in the way they are used in the underlying management of ourselves as psychophysical machines¹. Alexander referred to it as *the use of the self*.
29. At a very basic level, a useful distinction we can make is between the muscles which we use to bend ourselves or bits of ourselves, which are called the flexors, and those which straighten us up, which are called the extensors.
30. If you look at a chart of the human musculature, you will see that there are big swathes of muscles which spiral down from the head and neck through the torso and continue down through the legs.
31. When we tighten those muscles at the front of the torso, we tend to go inwards and downwards. They take us into a stoop or a crouch. The various muscles involved are acting as flexors. On a smaller scale, the biceps brachii is acting like a flexor when I bend my arm inwards towards me.
32. Acting in the opposite way to these flexors are those which are called the extensors. In the torso, they are in the back. They pull our shoulders back. They take us out of a crouch. They straighten our legs. They straighten out the arm.
33. When you look at any particular flexor or group of flexors, you always find there is an extensor or set of extensors which undoes the flexion. The muscle doing the contracting is sometimes called the agonist and the one on the other side is called the antagonist. Some times you will find them described as antagonistic muscles or exercising antagonistic pulls.
34. Normally when the agonist contracts, the antagonist yields automatically. This is referred to as Sherrington's Law of

¹ Alexander (1946)p50

Reciprocal Inhibition because he was the first to study its working at a neurological level.

35. A good example is the biceps. When it contracts, the triceps on the other side yields. When we want to straighten the arm, the triceps on the other side does the opposite job to the biceps.
36. But as always in these things, the everyday reality is quite complicated. Any time we want to, we can tighten both the flexors and the extensors and hold the arm in a rigid flexed or straight position.
37. I can demonstrate this with my model arm. First we have flexion when the biceps contracts and the triceps on the other side is inhibited. The lever action of the tendon on the lower arm pulls it towards the shoulder and the arm flexes.
38. You will notice, by the way, the lever action in which the elbow joint is acting as the fulcrum. For those who are particularly interested, this is a third class lever.
39. Then we have the antagonist unflexing or extending it. And when both act together, the arm is stiffened.
40. When we are exercising conscious control and doing this deliberately this fine. But suppose we have got into the habit of keeping the arm stiffer than it needs to be, the muscles on both sides are now pulling the joint more tightly together than necessary. This means that when we use it, there is extra wear and tear on it. And eventually this can lead to arthritis and all sorts of other problems.
41. This tightening is not just confined to the elbow joint. It is a bit harder to see but the same applies to all the other joints. The knees, the ankles, the wrists, the fingers and the neck.
42. I was going to look at the question of standing but that will wait until the next time. So I'll finish by just looking at what we mean by the antigravity muscles.
43. There is a sense, in which a lot of the things we do, like getting out of a chair, climbing hills, going up stairs, lifting and moving things and so on involve acting against the downward pull of gravity. We can talk about the muscles involved as being anti-gravity. We could think of lifting a telephone directory as being "*an antigravity exercise*".
44. As far as I know, the phrase goes back to Sherrington and Magnus who used it when they were doing their postural

experiments on animals. They used the phrase in a particular technical sense.

45. If you look at an animal such as a cat or a dog, the anti-gravity muscles are those which are used to keep it in its characteristic standing or sitting shape in the earth's gravitational field.
46. In the case of a dog, say, the antigravity muscles keep the head from drooping down. They keep the jaw from dropping open and in the case of the felines, in particular, they keep the tail from dropping. Think of the distinctive shape of a dog, a cat, a rabbit, a giraffe, or a kangaroo and how much more formless they look when their antigravity muscles are relaxed and they are asleep or dead.
47. In the case of humans, the same is true. The anti-gravity muscles keep our back in a nice upright position, they also keep the lower jaw closed. They give us our shape and when we are standing, they prevent us collapsing in a disorderly heap on the ground.
48. One set of muscles which is of particular interest to us as AT teachers is at the back of the neck. Because the skull is not perfectly balanced on the top of the cervical column, these muscles are normally slightly contracted or tightened to prevent the head dropping forward under the action of gravity.
49. These can also be seen as anti-gravity muscles if you wish. But we know they have a much wider significance for the functioning of the entire body.
50. Another term for the muscles which the body uses to keep itself upright and in its proper shape in the gravitational field is "*the postural muscles*". I prefer it to the term anti-gravity because it is a bit more precise about what they do.
51. I think this is a good place to stop. Next time I will look at the complicated business of standing and lengthening against gravity.

REFERENCES

F. M. ALEXANDER (1946) *The universal constant in living* - Mouritz, London (2000 edition)