

No 13 Reflex, habitual and voluntary actions (I)

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1. Today I am going to talk about the way we use ourselves or in ordinary language, the way we do things.
2. Using ourselves or doing things means using our voluntary muscles. These are the muscles which are to a greater or less extent under our conscious control. They are also called the skeletal muscles because the vast majority of them are connected to the bones of our skeleton.
3. There is another set of muscles that belong to the autonomic system and they deal with things like the movements of the gut, the standing up of the hair, the dilation of the iris and the circulation of the blood.
4. These are a different kind of muscle tissue, usually referred to as smooth muscle. They are controlled from the hypothalamus which puts them outside the direct conscious control of the brain.
5. There are various ways in which they can be influenced indirectly but because they are not subject to direct conscious control, they are, in effect, outside the scope of the AT and I will not be looking at them.
6. There is plenty to be going on with in the skeletal muscles of which there are about 600 in the body. They range in size from big ones like the trapezius or the quadriceps to the smallest called the stapedius in the inner ear which is only one millimetre long.
7. The actions of these voluntary or skeletal muscles can be divided into three categories depending on how they are controlled by the brain and the nervous system when they are being used. These three categories are:
 - Reflex
 - Habitual
 - Voluntary
8. There is not a separate set of muscles for each of these categories. All three control systems act on the voluntary muscles and there is a surprising degree of overlap between them. When we are performing even a simple act, it is likely to involve reflex, habitual and voluntary elements. We should not be looking for rigid distinctions.

9. Broadly speaking, a reflex act is something we are born with the potential capacity for doing; it is part of our neurological make-up. It happens without us thinking about it.
10. A habitual act is something we have learned, consciously or unconsciously, but which we do automatically, without thinking about it.
11. A voluntary act is something we decide to do and then do it. It is sometimes called a willed action.
12. Sir Charles Sherrington explains the difference between the three very clearly. In his most famous book *The integrative action of the nervous system*, he writes:

*Habit arises always in conscious action; reflex behaviour never arises in conscious action. Habit is always acquired behaviour, reflex behaviour is always inherent and innately given. Habit is not to be confounded with reflex action.*¹
13. I am going to start by looking at reflex actions about which there is a lot of confusion. When I was looking for a precise scientific definition of the word reflex, I came across a scientific paper written in the year 2000. It is called *What do reflex and voluntary mean? Modern views on an ancient debate*.
14. This discusses the question in considerable depth and concludes by saying that “*present-day researchers still cannot reach a consensus on what exactly the words reflex and voluntary actually mean.*”²
15. So if you find you are occasionally a bit confused when trying to figure out what different people mean when they are talking about reflexes, you are in good company. The fact is there is a lot of ambiguity and there is no definition of the word reflex that is accepted by everyone; different people use it to mean different things.
16. Because of this, Walter Carrington used to caution us about using the word reflex when we are talking to pupils about our work. That does not mean we should not use it. It is a useful word and we need to know about it because it is so commonly used.

¹ Sherrington (1906)pxvi

² Prochazka (2000) 417

17. Provided we know what we mean by it, and can explain to our pupils or fellow teachers what we mean when we use it, I see no reason not to use it with discretion.
18. Let us begin by looking at a few very definite reflexes about which there is no dispute.
19. When a bit of dust gets into the eye, there is an automatic or reflex blink. When we touch something hot, we automatically pull away from it.
20. The pinna reflex is a nice way of teasing a cat or dog. If you gently touch its ear, even when it is asleep, it flicks the ear. This is an reflex response to a stimulus such as an insect landing on the ear.
21. The way a dog automatically scratches its shoulder when it senses something that might be a flea is called the scratch reflex and also happens quite automatically, even when the dog is asleep. This is quite an elaborate reflex and uses a lot of muscles.
22. One of the most complex and extensive of all reflexes is the startle reflex which involves hundreds of muscles all over the body. When we hear a sudden noise, or something unexpectedly touches or hits against us, especially from behind, we immediately stiffen. This is an automatic protective response which is usually accompanied by rapid breathing and increased heart-rate.
23. It is sometimes referred to as the “fight or flight” reflex and puts the body on an emergency footing. It prepares the body for intense muscular action. It shuts down non-essential functions like digestion; it causes adrenaline to be released; it speeds up the heartbeat; and generally prepares use for dealing with immediate danger.
24. Another interesting reflex is the stretch reflex, this is also called the “myotatic reflex” – when you see “myo” in a word it usually means it has to do with muscle. The myotatic reflex is the contraction which occurs in a voluntary muscle when it is stretched by an external force.
25. Muscles and tendons have various kinds of sensors in them and when a muscle is stretched, even very slightly, these sensors are stimulated and they send signals to the central nervous system which in turn sends out a signal to the muscle to contract.

26. This is a protective reflex. If someone starts to pull our arm, the muscles in the shoulder tend to tighten up before the arm is pulled out of its shoulder joint.
27. This stretch reflex often shows up in the postural muscles. If I am standing in a relaxed way and I start to go off balance, some of the postural muscles that have been gently and quietly keeping me in balance are stretched. The stretch reflex tightens them to stop me going further off balance and I immediately stiffen.
28. The stretch reflex is also what makes the knee-jerk or patellar reflex happen – that is the one when the doctor taps just below your knee.
29. The tendon of the big quadriceps muscles in the front of the thigh runs under the patella, or kneecap, and attaches into the front of the tibia. When the doctor gives the tendon a little tap, just below the patella, it stretches the quadriceps which immediately responds by tightening and lifting the lower leg.
30. Every vertebrate creature has its own built-in set of reflexes. They are part of its genetic inheritance. A cat and a rabbit sit, run and jump in their own particular in-built way. For those of you who like computer analogies, this in-built set of reflexes could be called our muscular operating system.
31. When a human baby is born, it has its own set of inbuilt reflexes. But it obviously takes some time for the muscles to develop enough to put these reflexes into action.
32. If we observe a tiny baby closely we can see its muscular development as it kicks and waves its arms about and gradually starts to move itself around. Nobody needs to teach it to stand. As soon as they are ready for it, babies stand up, they balance, they begin to walk.
33. This definition of a reflex as part of our genetic inheritance is both clear and useful but the problem is that in general use and even among scientists, the word reflex is often used in a much more general way than in these examples.
34. Sometimes it is used to mean a very quick reaction. When a person reaches out quickly to stop their pint of beer falling in a pub, or someone suddenly slams on the brakes in a car to avoid an accident, people often say they showed quick reflexes.
35. We get very interesting and extreme examples of quick reactions in sports. A goal-keeper saves a point-blank shot at

goal and sports commentators and journalists talk of a reflex save. Top tennis players are able to return a hundred-mile-an-hour service, or sprint athletes are able to get out of their starting blocks in a tenth of a second. We say they have amazing reflexes.

36. The important feature of these abilities, which they share with reflexes, is that they bypass conscious thought. If you start to think about what you are going to do in these situations, the moment will have passed and it will be too late.
37. The beer will be all over the floor, the tennis ball will have passed you or the other runners will be ten metres up the track while you're saying to yourself, "Better do something about this – time I got moving."
38. So these are not reflexes in the Sherringtonian sense. No one is born with these abilities. They have to be learned. Some people may be able to learn them more quickly than others but no one is born with the ability to deal with hundred mile-an-hour tennis services.
39. To be able to do these things people have to spend a lot of time practising how to return tennis services, catch fast-moving footballs, leap out of the blocks at the sound of the starter's gun and the rest of it. Eventually, they will have learned whatever it is so thoroughly that it can be done without any conscious thought. It has become completely habitual. But it is a learned rather than an innate response
40. Another confusing use of the word reflex was made famous by the Russian scientist Ivan Pavlov. When a dog sees or smells food, it shows an overall muscular interest and it automatically salivates. This is actually quite a complex reflex response. It involves both non-muscular glandular activity in producing the saliva and muscular activity in the jaws and the neck and elsewhere.
41. What Pavlov did was to associate the sight of food with the sound of a bell or other signal. The bell would ring, the food would be presented, and the dog would salivate.
42. After repeating this procedure a number of times, Pavlov found that the dog began to associate the sound of the bell with the food and would salivate at the sound of the bell. This became known as a conditioned reflex.
43. Again this is a learned response. Dogs do not normally salivate when a bell rings but Pavlov showed that they can be

taught, or conditioned, to do so. He had created a habit in the dog.

44. That's all we have time for today. Next time I will start with our voluntary actions and look further into the intricate way in the three muscle control systems interact with each other in our daily lives and our work as AT teachers.

REFERENCES

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