No 6 TOUCH and PRESSURE

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1. Today, I thought it would be worth having a look at the subject of pressure and its subset touch. Physiologically, we are remarkably well-equipped to measure pressure in a variety of ways.
2. It accounts for a significant proportion of the activity of the central nervous system which is a pointer to its importance in our general physiological functioning. And, of course, it has a lot of relevance to the work we do as AT teachers.
3. First, the word itself. Pressure has a large spread of popular meanings, most of them negative. We talk of being put under pressure at work, the pressure of exams on young people, the financial pressures on families, on Alexander teacher-training schools and so on.
4. I suppose the general sense of it is on things being squeezed or pressed upon. All in all, pressure sounds a bit of a bad thing.
5. But there is another more scientific use of the word pressure which does not have these negative connotations. So I will begin by looking at what pressure means in a purely scientific sense before moving on to look at it in the context of our work.
6. Pressure is formally defined as the force per unit area. The best way of explaining it is by looking at stiletto heels.
7. We all know that if a person wearing sensible shoes with flat heels walks around on a polished wooden floor no damage will be done. But if the same person puts on a pair of stiletto heels, they will ruin the floor. Similarly, if you are walking on your tiled patio in your stilettos and you step on to the lawn your stilettos will sink in it.
8. So what is the difference between the flat heel and the stiletto. It is not the height. That raises other questions about balance and what is good for you. The important difference for our purposes today is the area of heel in contact with the ground.
9. Whether a person chooses to wear flat heels or stilettos, their weight remains the same. The difference in the behaviour of the heels is that in the case of the flat heels the weight is spread over a larger area than when the person is wearing stilettos.
10. I said pressure is defined as the weight, or force, per unit area. I have done the calculations comparing the pressure on the ground by someone wearing sensible heels and stilettos.

11. It turns out that for the example I took, the pressure exerted by the stilettos is one hundred times greater than that exerted by sensible heels. I have put the exact figures in the version of this talk on my website.[1]

12. Other things being equal, it is not the weight of the person as such which causes the damage but the extent to which it is concentrated which causes the damage.

13. Most people have an intuitive sense of this and it is something we make use of at a practical level all the time. We put things under the legs of tables and chairs to reduce the pressure and prevent them digging into the carpet. We use wide straps on our backpack to prevent them digging into our shoulders. If we live in a cold country we use snow-shoes to walk on snow.

14. This is also helps explains why elephants have large feet. They are big heavy beasts and they tend to live in dry sandy areas. Their very wide feet spread their weight so they don't sink in the ground.

15. So my practical hint for people on a wild-life safari, if it should come to it that you are running away from an elephant on soft sandy ground, take off the high heels.

16. I can show this clearly with this piece of wood which is flat on one end and narrowed to a point on the other end. If I squeeze the wood between my hands, the actual force is obviously the same at both ends.

17. But while I find the thick end causes no problem, it is obvious I could easily break the skin of the other hand with the pointed end. The pressure applied by the sharper end is much greater than that at the blunt end.

18. But the fact that reducing the area over which the load is applied increases the pressure is not always a bad thing. There are times we want to do it.

19. We sharpen a stake if we want to drive it into the ground. This also helps explain why knives cut and nails go into wood. In all these cases we are deliberately making the area over which the force is applied so small that the pressure is high enough to penetrate the material.

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[1] Assume the person weighs 60 kg which is 30 kg on each foot. Assume two thirds of the weight goes on the heel of each foot. If the sensible heel is 5 x 5 cm and the stiletto is 0.5 cm, the pressure under the sensible heel is 0.8 kg/sq cm and under the stiletto is 80 kg/sq cm, a hundred times as much

20. In the AT word, things take place in a much gentler way. But we all know the difference between pressing your flat hand on someone and using the same force to give them a poke with your finger.

21. After this introduction to the basic idea of pressure, I now want to look at how the concept translates into physiology and then move on to its relevance for us as AT teachers and students.

22. As I said, as human beings, we are extraordinarily well equipped to detect pressure and changes in pressure. The human body especially, the skin, is absolutely packed with different types of sensors or pressure receptors which do the job for us.

23. A simple example of these sensors in action is if we are in the dark and we put a hand on someone, how do they know it? They know it because of the pressure sensors in their skin. That is also why we ourselves know that our hand is on someone because there are similar pressure sensors in our own skin. Touch is a two-way process.

24. These pressure sensors are of various types and have different roles in the body. Each one of them is connected by its own nerve fibre into the central nervous system. When the sensor responds to a pressure signal, a nerve impulse is sent from it into the spinal cord and up into the part of the brain known as the somato-sensory cortex.[2]

25. Let us now look at the different types and where they occur. In sensitive hairless skin areas such as the finger-tips, the palms of the hands, the lips, and the eyelids, there are quickly responding tactile sensors called Meissner corpuscles[3]. These give us what we often refer to as our sense of touch.

26. There are huge numbers of these. One source I looked at said there are about 1,500 per square cm in the finger tips. They are extraordinarily sensitive and are located near the surface of the skin.

27. It is because of these that we have no problem detecting a fly tramping round on us. They enable us to detect tiny irregularities in a surface when we gently rub a finger tip across it. If we gently draw the tip of a finger over one of our lips we get a barrage of sensations from both the lip and the finger-tip.

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[2] Tortora (2000) p495
[3] Ibid.p489

28. In the same hairless skin areas, there is another type of sensor, known as a Merkel disc or cell[4]. These lie slightly more deeply in the skin. They are not quite as numerous as the Meissner corpuscles but there are plenty of them. A figure I have is 750 per square cm in the finger tips.

29. They were given their name long before Angela but, perhaps appropriately, they are slower to respond and require a greater pressure to activate them than the Meissner corpuscles. One might say they respond to a firm hand.

30. In the areas where there is hair on the skin, each hair also acts as a touch receptor. There is a tiny muscle in the hair follicle which has its own nerve fibre connecting it into the nervous system.

31. Because of this can one easily detect a hand being brushed gently above the skin so that it is just touching the hairs and not the skin. The reason we are able to detect a touch on our hair is that it has been picked up by the little muscle in the follicle.

32. A little further into the skin, in the sub-cutaneous layer, there is another type of sensor known as a Ruffini corpuscle. This is sensitive to continuing pressure as opposed to short-duration touch.[5] These are particularly found in the palms of the hands and the soles of the feet – otherwise known as the plantar areas.[6]

33. Those in the feet tell the nervous system about the way our weight is distributed on the soles of our feet and when we shift forward or back or from foot to foot. I will have more to say about them.

34. The final set of pressure sensors that I want to mention are called Pacinian or lamellated corpuscles and these are sensitive to pressure conditions deep inside the body. They are widely distributed throughout the body especially around the joints, tendons and muscles.

35. These tell us about how the weight is distributed between the different bits of ourselves. It is because of these that we can, for example, notice the change in our pelvis when we shift our weight from one foot to the other.

36. They also tells us something about when we give ourselves a tight squeeze. And if someone else gives us a squeeze and

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[4] Ibid.p489
[5] Ibid.p489
[6] Ibid. p489

we squeeze back there is quite a hubbub in both sets of Pacinian corpuscles.

37. Now imagine you are standing in the Piccadilly Line in rush-hour, with people squashing against you on all sides. Your whole range of pressure sensing equipment gets a good workout. The person's hair brushing against your face is stimulating the Meissner corpuscles in your face while the briefcase pressing into your back is getting your Merkel discs going.

38. The fact that you are being forced to stand on your right foot means that Ruffini corpuscles in its plantar area are signalling far more strongly than those in the left foot which is hardly touching the ground. The brain will be getting a flood of information from which it can deduce that you are not in an optimum standing state. And the general crush of bodies against you is mobilising your Pacinian corpuscles in a big way.

39. If we now think of something less dramatic than the Piccadilly Line in rush hour, such as putting a hand on someone and gently persuading them to adjust their position, we see it is not the simple process it might appear to a non-AT person. It is, in fact, stimulating a highly complex set of nerve impulses of various kinds in both the pupil and the teacher.

40. Next time we will have a look at that in detail and see if we can unpick what is going on.

REFERENCES

G. J. TORTORA S. R. GRABOWSKI (2000) *Principles of anatomy and physiology* - John Wiley and Sons, 9th ed