When I say . . . embodied cognition

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As an experienced interventional radiologist and clinician-educator, Irene demonstrates how to insert a drain into an obstructed kidney. She talks to a resident, visualises the kidney using an ultrasound device held in one hand and inserts the drain with the other, while carefully observing the patient's breathing. Almost magically, the needle tip slides smoothly into the middle of the pyelum. The next patient will be the resident's case.

This anecdote represents a daily clinical act of the type known to health professionals. Many practitioners, such as those working in surgery, gynaecology, dentistry, nursing, physical therapy and other domains, perform techniques that demand complex skills based on eye–hand coordination in interaction with clinical knowledge and factors within the environment (e.g. patients, tools, colleagues). From a traditional cognitivist perspective, such acts can be described as making mental representations of the patient's disease or abnormality. The professional uses schemes or scripts for clinical reasoning, for analysing the situation and for making decisions. Next, he or she takes appropriate steps to treat the patient. Consequently, the health professional's mind can be seen as a storehouse of representations and mental schemes used for a form of computation facilitated by the prefrontal cortex.

By contrast, theories about embodied cognition claim that the mind, body and environment are interrelated and mutually dependent.[1] This general claim applies to the work of all physicians and learners and is not related to a particular specialty. Cognition is not only a capacity or ability of the brain. Rather, cognition is shaped by bodily experiences in the physical and cultural environment.[2] From an embodied cognition point of view, 'knowing how' is the ability to coordinate mind, body and tools in an environment into a dynamic system geared to a specific purpose. Sensory perception and movement are important in this dynamic process. This insight into the salience of perception is reflected in natural languages. If we understand something, we may say that we 'grasp', 'get' or 'see' it. Having a 'feel' for something often refers to having a particular intuitive ability.

This is what happens in our example. First, the kidney, as visualised by Irene, is not really seen or physically contacted, but is observed on a screen and imagined when touching the patient. This 'image' of the kidney, as well as Irene's knowledge about the drain and the patient's breathing pattern, facilitate her motor activities as she inserts the drain. This is an automated, routinised process for experienced interventional radiologists. Action and perception are interrelated and constrained by factors in the clinical environment in the moment (e.g. the patient, colleagues, instrumentation and trainee).

Irene acts intuitively and successfully, without much deliberation, in response to affordances for action offered by the clinical environment; that is, by 'seeing' and 'feeling' the best way to handle her tools. Her actions are based on internalised, probably tacit, knowledge and form a dynamic

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system. Actions may be related to feelings that cannot always be explicitly described or verbalised, a phenomenon named 'tacit knowledge' more than half a century ago by Polanyi.[3]

Irene is guided by the affordances of the ultrasound scanning device. Like a chair affords the action of sitting down, and a doorknob affords the action of grasping, so does an ultrasound scanner afford a skilled interventional radiologist the ability to perceive a kidney and to approach it with a drain. Action and perception are bound by purpose; the specialist sees and feels the environment based on her ability to act in it. It allows her to pick an efficient and effective approach, given her set of potential actions.

Embodied cognition theories range from a more conservative recognition that cognitive internal representations have a bodily origin to a radical enactivist view that avoids assumptions about internal representations. What these theories have in common, being fundamental to an embodied viewpoint, is that cognition sparks from stimulating a motor-action neural circuit during bodily interactions with the physical environment. A surgeon's skilled fingers can tacitly separate a scar from delicate vessels without damaging structures. Such experts have abilities to 'see' relevant parts at a glance and to fluently distinguish complex patterns and details and integrate these with physical movement with minimal cognitive effort. In developing these skills, experience-induced improvements in the perception of and response to possible situations in the environment are key. If rehearsed, these perceptions and responses become refined over time. In the long run, a surgeon's motor-action neural circuit can be stimulated even when the surgeon only imagines a clinical activity.[4] Many skills develop iteratively using responses of the body to detected situations in the physical environment. Subsequent sensations activate areas of the surgeon's motor cortex in both imagined and actual practice. Health professional activities typically involve much more than prefrontal cognitive processes. Physical examination, with its visual, auditory and tactile information recognition, not all of which is expressible in words, can become embodied.

Embodied cognition is relevant in health care as well as in medical education. This is analogous to 'knowing how' to ride a bicycle, which is quickly embedded in a more or less physical, unconscious memory after initial training. For instance, conducting a skilful colonoscopy requires abundant training until the fellow gastroenterologist has integrated the right 'feeling' and 'timing' in manipulating the scope to avoid inadvertent loops, and can focus all cognitive resources on screening, finding and addressing the pathology. This does not hold for procedural specialties only. Experienced intensivists, cardiologists, gynaecologists, psychiatrists, family doctors and others see, hear, feel and recognise essential medical conditions, and act in ways they are often hardly or not consciously aware of. Likewise, decisions to trust trainees with critical health care tasks may involve gut feelings that cannot easily be expressed in words by experienced educators.[5] The upcoming domain of embodied cognition deserves the interest of health professions educators.

REFERENCES

1 Anderson ML, Richardson MJ, Chemero A. Eroding the boundaries of cognition: implications of embodiment. *Top Cogn Sci* 2012;**4** (4):717–30.
2 Varela FJ, Thompson E, Rosch E. *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge, MA: MIT Press 1991.
3 Polanyi M. The logic of tacit inference. *Philosophy* 1966;**41** (155):1–18.
4 Barsalou LW. Perceptions of perceptual symbols. *Behav Brain Sci* 1999;**22** (4):637–60.
5 ten Cate O. Trust, competence and the supervisor's role in postgraduate training. *BMJ* 2006;**333** (7571):748–51.

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