Embodied Mathematics

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For Mercy has a human heart,
Pity a human face,
And Love, the human form divine,
And Peace, the human dress.
"The Divine Image," William Blake, *Songs of Innocence*, 1789

For many individuals, mathematics is experienced and remembered as a discipline without a human heart, face, form, or dress; a largely, if not strictly, cognitive endeavour for the select few. Recent research in cognitive neurobiology, linguistics, anthropology, and a host of other disciplines, however, is converging on a view of learning that, though socio-historically situated and mediated through cultural artifacts, is heavily influenced and constrained (if not determined) by our body and brain. For example, our predilection as a species for symmetry is thought to be related to the evolution of our neural circuitry and sensory apparatus in particular kinds of environments, with particular kinds of stimuli and selection pressures. The questions provoked by the discussion that follows are "What role, if any, does the body play in shaping the creation and understanding of the body of mathematics?" and, by way of speculation, "Can understanding the humanness of mathematics contribute to the humane-ness of mathematics education (i.e., to mercy, pity, peace, and love)?"

George Lakoff and Rafael Nunez in their influential, though controversial, book—W*here Mathematics Comes From*—describe what they consider to be a general "romance of (Western) mathematics," namely, that: 1) Mathematics is abstract, disembodied, and yet somehow "real"; 2) mathematics has an objective independent existence; 3) human mathematics is just a part of abstract, transcendent mathematics; 4) mathematical proof allows us to discover transcendent truths of the universe; 5) mathematics is part of the physical universe and provides rational structure to it; 6) mathematics even characterises logic, and hence structures reason itself; 7) to learn mathematics is therefore to learn the language of nature; and 8) since mathematics is disembodied and reason is a form of mathematical logic, then reason itself is disembodied.

This particular view of mathematics gives rise to conceptions of mathematics that privilege symbolic forms of reasoning over other types. Such a view fits with views of cognition in which thinking is essentially the manipulation of internal "representations" of an external objective reality. Such a view does not require that mathematics have a human heart, face, or dress; indeed from this view, which emerges from a strict dualism between mind and body, mathematics becomes potentially disembodied. Embodied cognition is a response to this "cognitivist paradigm" and rejects this strict dualism in favour of viewing mind and body as co-implicated and co-specifying systems.

The guiding assumption of embodied perspectives is that minds require bodies in order for them to function. Embodied perspectives ask "To what extent is sensorimotor processing implicated in cognition?" and holds the view that human cognition is body based. One of the central claims of embodied cognition is that we offload cognitive work onto the environment. The argument here is that we reduce cognitive workload by strategically leaving information in the environment rather than fully encoding it, and can alter the environment in order to reduce cognitive work further. For example, activities that are both situated and spatial, such as when we count on our fingers, draw Venn diagrams, and do math with pencil and paper, are advantageous since by doing actual, physical manipulation, rather than computing a solution in our heads, we save cognitive work thus overcoming the limitations of working memory capacity. When these activities become decoupled from their embodied situations they are capable of being used to represent abstract domains of thought such as mathematics.

But what else does drawing attention to the body in mathematics offer? A recognition of the important role of the body in mathematical cognition serves to re-establish a sensuality of mathematics that “cold” cognitive approaches eschew. Another benefit is the potential awareness that comes from asking questions about whose bodies are actually represented (usually dead, white, heterosexual European males) or not represented (typically women, minorities, non-heterosexuals) in mathematical discourse, how they are represented, and how such presence or absence is felt and experienced by real bodies. This perspective also draws attention to the fact that much of human activity, which might not be seen as formal academic mathematics, probably involves implicit mathematical ideas such as recursion and pattern formation. As such, these body and sensory experiences that are already familiar to learners could be used to establish connections to more formal mathematical ideas. The Divine Image of mathematics may not be transcendent but might have a human form after all!

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