

Time to Flip the Pain Curriculum?

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“I had a crazy upside-down way of presenting quantum mechanics, absolutely inside-out, in which everything that was advanced would come first, and everything that was elementary, in the conventional sense, would come last.”¹

—Richard Feynman, Ph.D.
(1918–1988; Professor,
Department of Physics,
California Institute
of Technology, Pasadena,
California).

WITH reluctance, the Nobel Laureate Richard Feynman was persuaded in 1961 to teach introductory physics to undergraduates at California Institute of Technology, Pasadena, California. His creativity and insight led him to approach this challenge in a novel way, producing an iconic series of lectures and a landmark text that has inspired students for over 50 yr. Today’s educational innovators speak of “flipping the classroom”: using Internet-based distance learning to convey factual content, thereby freeing up time in face-to-face or online class discussions to explore students’ questions about content or assignments. A concurrent trend in this era of patient-centered practice is the increasing attention given to pain in medical education.² We believe, however, that the now-standard approach to pain education, which begins with and emphasizes processes at the subcellular and cellular scale, poorly prepares trainees to assess and treat pain in everyday clinical practice.

The anesthesiologists Beecher and Bonica demonstrated that context plays a major role in the experience of acute or chronic pain, an insight that led Melzack and Wall to propose their seminal “gate theory” of endogenous modulation of nociception.³ Recent anatomical (*e.g.*, functional magnetic resonance imaging) and biochemical (*e.g.*, oxytocin related) studies affirm and extend earlier evidence that a dysphoric social dimension involving isolation, withdrawal,



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distress, and often stigma contributes to the multidimensional experience of pain nearly as much as does nociception *per se*.⁴ Every mother who soothes and promptly settles down her crying toddler after a minor scrape or tumble—essentially, every mother—knows this instinctively. In contrast, the clinician trained to think that “mechanism-based pain therapy” is limited to an initial appraisal to decide whether the patient’s pain is neuropathic or nociceptive, followed by detailed testing to assign a phenotype of aberrant ion channel expression or other cellular-level phenomena, risks overlooking mechanisms involving group processes. However, group processes (*e.g.*, family, job, culture, religion) unquestionably mold the experience, report, and response to therapy of acute, chronic, and cancer-related pain. Failure to address the social dimensions of pain can render rehabilitative efforts futile.⁵

For the above reasons, and inspired by Feynman’s bold inversion, we propose that pain education could be improved by “flipping the curriculum.” In this new approach, students would be offered a perspective on pain as a population-based social phenomenon whose mechanisms and mediators at the cellular level have evolved through evolutionary differentiation and selection over hundreds of millions of years.⁶ In other words, we propose to reframe the pain curriculum from its current standard formulation as a bottom-up “biopsychosocial” phenomenon to a top-down “sociopsychobiological” one. We believe that “hard” scientific evidence supporting the reframing of pain as an interpersonal, inherently social process has accumulated to reach a tipping point such that relatively little effort will be needed to implement this change.^{2,4,7}

How is the biopsychosocial model of pain taught at present? Typically, early chapters or opening lectures emphasize

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neurotransmitters, ion channels, and ligand–receptor interactions that trigger microscale events culminating in the generation of an action potential, followed by the subsequent cascade of neural responses that ultimately leads to fuzzily defined sequelae such as suffering, isolation and pain behavior, and impaired social and vocational function. In other words, much more attention is focused upon the “bio” than the “psycho,” and still less upon the “social.” Yet in reality, an important component of the functional magnetic resonance imaging signature for human pain involves areas of the brain also activated by intersubjective processes including empathy, social bonding, or isolation-induced suffering.^{4,7} This recent insight indicates that more attention deserves to be given to social, followed by psychological, and last, biological dimensions of pain in society, that is, a sociopsychobiological model.

The current biopsychosocial model encourages medical students and physicians to view as distractions the emotional upset, family dysfunction, and economic stress that engulf everyday patients with pain seen in the clinic. Students and trainees are encouraged to see through these messy and disturbing layers to make the pain diagnosis in impersonal, mechanistic terms—the smaller the scale, the better (*e.g.*, ectopic discharge, glial activation, and so on). These seeming distractions and epiphenomena, however, are arguably closer to the essence of pain than are idealized reductionist models. A fundamental grounding in the neuroscience of population-based social interactions⁸ would better help students and young doctors understand, among other topics, the intersubjective aspects of a patient’s pain, its corrosive effect upon family and other social dynamics, and the relationships between prognosis, disability, and disability payments. The emerging field of social neuroscience—the exploration of the neurological underpinnings of the processes traditionally examined by, but not limited to, social psychology—draws upon disciplines that include neuroscience, social psychology, developmental science, economics, and cognitive psychology.⁹ Introduction of these concepts early into the medical curriculum would emphasize their importance not only for the treatment of pain but also for the daily practice of medicine. Other population-based concepts that warrant early presentation in a flipped pain curriculum include epidemiology of pain and disability, substance abuse risk stratification, social and behavioral medicine, social networks and their properties,¹⁰ and the organization of healthcare systems and how to optimize their function (including that of inter-professional teams). Keeping in mind that Darwin’s later work, now termed “social Darwinism,” extended his initial concept of survival of the fittest from the individual to the group level, we would further approach the origin of medical ethics as a population-based process. To quote Darwin, “any animal whatsoever, endowed with well-marked social instincts...would inevitably acquire a moral sense or conscience.”¹¹ Components of a pain-related, population-based

ethics curricular content include human rights, social justice, global health, and access to equitable care.

To help students develop an intuitive sense of particle physics without getting bogged down in complex calculations, Feynman devised simple graphical representations to elegantly represent complex interactions. In a parallel manner, should we wish to focus students’ and trainees’ attention upon the key events in the clinical trajectory of a patient with pain, we could offer simpler, aggregate-scale organizing principles that encompass yet transcend microscale events. This is not to say that the latter processes are unimportant; they certainly are, especially for specialized activities such as designing novel analgesic molecules or better understanding the pharmacodynamic effects of existing agents given alone or in combinations. Furthermore, the treatment of individual patients requires titration of pharmacological agents to the individual’s response; interventions such as regional anesthesia should only be provided using techniques that accommodate and identify individual anatomic variations. Thus we are by no means suggesting that educators must choose between a micro- or a macro-level conceptualization of pain, but simply that a more balanced and holistic presentation be provided. This suggestion has ample precedent. Already, many “hard science” disciplines such as physics or quantitative biology draw upon one set of models, formalisms, and laws to address problems framed at one scale, and use a different set for problems framed at another scale within a multilevel continuum.¹² In recent decades, physicists have viewed the study of the properties and interactions of the smallest particles as informing our understanding of large-scale properties of the universe itself.¹³ This is because the micro and macro properties are considered to be in equipoise. Likewise, the properties of the micro elements of the nociceptive system (nociceptors, ion channels, receptors, intracellular mediators, and so on) result from and are in equilibrium with macro-level, population-based gene selection across successive generations.

What advantage might there be in teaching about pain in a new way? To begin with, this flipped approach addresses two fundamental problems with current medical school curricula on pain. The first is the absence of a coherent viewpoint about pain linking the many instances in the curriculum in which pain-related preclinical and clinical content are presented. The second is that the standard approach to pain education proceeds from a reductionist starting point in molecular and cellular processes, progressing toward larger and larger scale processes as if these were simply the result of small-scale phenomena such as action potential generation or receptor–ligand interactions. Yet we know the flow of causality from element to aggregate does not always occur in reality—cathedrals may be constructed from bricks, but are not caused by bricks. Skyscrapers are not caused by steel and glass. Instead, cathedrals and skyscrapers result from a top–down flow of causality, starting with intentionality arising from intangible religious belief or aesthetic vision. Put

another way, the standard pain curriculum resembles an approach to driver education in which classes in combustion chemistry and auto mechanics were mandatory, while on-road training in courtesy and defensive driving amidst traffic were optional.

New medical graduates must be better equipped to address complex everyday pain and pain treatment–related problems such as disability certification, mental health issues, family embroilment, and diversion of analgesic medication. Increasingly, they do so as members or leaders of teams within complex healthcare systems.¹⁴ Already, several groups of North American medical and other health professional educators have echoed the 2011 Institute of Medicine endorsement¹⁵ of the “value of a public health and community-based approach” to the prevention and control of pain, and its call for “a cultural transformation in the way pain is perceived and managed” that explicitly includes changes in the undergraduate medical curriculum. The Institute of Medicine’s view is that “knowledge of pain needs to be enriched from the molecular and genetic to the cellular, neural network, and systems levels”; the report itself includes a systems map, “the picture of pain.” As we have observed in related comments, “This movement from reductionism toward accommodation of subjectivity and complexity is to be applauded. Not only does this movement help synthesize qualitative and quantitative modes of understanding, but a greater attention to complex patient-centered experiences can improve clinical outcomes and increase patient satisfaction.”¹⁶

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References

- Weiner C: Interview with Richard Feynman, 4 March 1966, Feynman’s Tips on Physics. Edited by Feynman RP, Gottlieb MA, Leighton R. New York, Basic Books, 2013, pp 21
- Murinson BB, Gordin V, Flynn S, Driver LC, Gallagher RM, Grabois M; Medical Student Education Sub-committee of the American Academy of Pain Medicine: Recommendations for a new curriculum in pain medicine for medical students: Toward a career distinguished by competence and compassion. *Pain Med* 2013; 14:345–50
- Carr DB, Cousins MJ: The anesthesiologist and pain—A historical memoir, *The Wondrous Story of Anesthesia*. Edited by Eger EI, Westhorpe RN, Saidman LJ. New York, Springer, 2014, pp 811–27
- Eisenberger NI: The pain of social disconnection: Examining the shared neural underpinnings of physical and social pain. *Nat Rev Neurosci* 2012; 13:421–34
- Carr DB: What does pain hurt? *Pain Clin Update* 2009;18:1–6
- Walters ET: Possible clues about the evolution of hyperalgesia from mechanisms of nociceptive sensitization in aplasia, *Hyperalgesia and Allodynia*. Edited by Willis W. New York, Raven Press, 1992, pp 45–58
- Wager TD, Atlas LY, Lindquist MA, Roy M, Woo CW, Kross E: An fMRI-based neurologic signature of physical pain. *N Engl J Med* 2013; 368:1388–97
- Freeman W: *Societies of Brains: A Study in the Neuroscience of Love and Hate*. Hillsdale, Lawrence Erlbaum Associates, 1995
- Decety J, Keenan JP: Social Neuroscience: A new journal. *Soc Neurosci* 2006; 1:1–4
- Prell C: *Social Network Analysis: History, Theory & Methodology*. Thousand Oaks, SAGE Publications, 2012
- Darwin C: *The Descent of Man, and Selection in Relation to Sex*. Selections and commentary by Carl Zimmer. New York, Plume, 2007, pp 157
- Carr DB: Pain therapy. Evidence, explanation—Or ‘the power of myth’? *Curr Opin Anaesthesiol* 1996; 9:415–20
- Sidharth BG: *The Thermodynamic Universe: Exploring the Limits of Physics*. Hackensack: World Scientific, 2008
- Fishman SM, Young HM, Lucas Arwood E, Chou R, Herr K, Murinson BB, Watt-Watson J, Carr DB, Gordon DB, Stevens BJ, Bakerjian D, Ballantyne JC, Courtenay M, Djukic M, Koebner IJ, Mongoven JM, Paice JA, Prasad R, Singh N, Sluka KA, St Marie B, Strassels SA: Core competencies for pain management: Results of an interprofessional consensus summit. *Pain Med* 2013; 14:971–81
- Institute of Medicine: *Relieving Pain in America: A Blueprint for Transforming Prevention, Care, Education, and Research*. Washington, The National Academies Press, 2011
- Carr DB: Twenty-first century pain education: The rediscovery of compassion. *Pain Med* 2011; 12:183–5