



# Gendered Innovations in Orthopaedic Science

## Gendered Innovations in Orthopaedic Science: Women (and Men) Who Rock

Amy L. Ladd MD 

**M**usic is a performing art that, on its surface, has little to do with science. Art is creative and emotional; science is (or should be)

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*Note from the Editor-in-Chief: We are pleased to present to readers of Clinical Orthopaedics and Related Research® the latest installment of “Gendered Innovations in Orthopaedic Science” by Amy L. Ladd MD. Dr. Ladd is a Professor in the Department of Orthopaedics at Stanford University, and is the Past-President of the Ruth Jackson Orthopaedics Society. She provides commentary on sex and gender similarities and differences in orthopaedics.*

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A. L. Ladd MD (✉)

Chase Hand and Upper Limb Center,  
Stanford University, 770 Welch Rd.  
Suite 400, Palo Alto, CA 94304-1801,  
USA

e-mail: aladd@stanford.edu

rational and objective—feminine versus masculine, to use the language of polarizing stereotypes. Important disciplines and discussions however, have at their heart both art and science, with yin and yang—feminine and masculine—duality.

“Women Who Rock: Vision, Passion, Power” from the Rock and Roll Hall of Fame reminds me of the dichotomy of art and science. Last summer, my teenage daughter and I took in the exhibit that honored the feminine “engines of creation and change in popular music” [18] at the Henry Ford Museum in Dearborn, MI, USA [21]. Inside, we found emblems of women who rocked the world—Billie Holiday’s silver fox fur stole, Stevie Nicks’ orange and gold gossamer dress, Chrissie Hynde’s red leather biker jacket, and Janis Joplin’s crib notes to “Move Over” sprinkled among other handwritten lyrics.

What do these legendary musicians have to do with sex and gender in orthopaedic science? The content and shape of popular music, not surprisingly, follows the cultural trends and our social consciousness. Bessie Smith [3] fought for the microphone to sing and expose racial injustice. Janis Joplin [11] screamed for social change. Aretha Franklin [1] demanded R-E-S-

P-E-C-T. Often edgy and persevering, these pioneers quite literally sought a voice, and as they found their own voices, they transformed the zeitgeist of popular music.

Initiatives related to Science, Technology, Education and Mathematics (STEM) programs [5, 9, 14] can provide that much-needed voice for women in orthopaedics. According to the American Academy of Orthopaedic Surgeons (AAOS), women constitute 12% of academic faculty in orthopaedics and 7% of practicing orthopaedists [16]. STEM programs like the Perry Initiative [22] and Nth Dimensions [15] help combat these statistics by bringing girls and underrepresented minorities into the educational fold as future scientists. The Perry Initiative targets high school girls and underrepresented minorities who engage in a life-changing, day-long, hands-on orthopaedics and bioengineering workshop. A similar pipeline program is Nth Dimensions, the brainchild of orthopaedic surgeon, Bonnie Simpson Mason, the AAOS 2015 Diversity Award winner [14]. Nth Dimensions partners with medical specialties that have considerable shortages in women and underrepresented minorities. These programs introduce real life, hands-on experiences for those who might not otherwise have

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knowledge or access to scientific domains from astrophysics to orthopaedics.

As sex and gender becomes a more high-profile topic in scientific research [23], two things are likely to happen: More women will see opportunities in the sciences, and new discoveries will be made by men and women, discoveries that improve the lives of men, women, boys, and girls. How the sex of the cell alters disease manifestations; how fragility fracture rates, incidence, and mortality differ between men and women are just a few of the many examples. As funding and attention flow towards these areas of inquiry, more women at an earlier age will become drawn to orthopaedics.

Just as STEM programs aim to improve diversity in orthopaedics, a relatively new twist on STEM—STEAM [12, 19]—aims to improve art and design in scientific innovation. The “A” in STEAM represents Art, and in traditional terms, Arts and Humanities. Even surgeons and scientists need a firm grounding in the arts and humanities; in order to win over investors to support an invention, to convince a corporation to bring a device to market, or simply to present their work effectively as a lecture or monograph. Those of us working in scientific disciplines need to be able to tell a good story.

Formal training in arts and humanities, and exposure to drama, literature, history, sociology, graphic design, and,

yes, even rock and roll music—as STEAM programs now provide—will produce a different kind of orthopaedic scientist. One that is both data-driven and open to qualitative information. In our digitally driven, on-demand, pay-for-performance world [2], being a keen observer makes for better doctors. Spoiler alert: We become empathetic listeners and make more accurate diagnoses when we just slow down and observe.

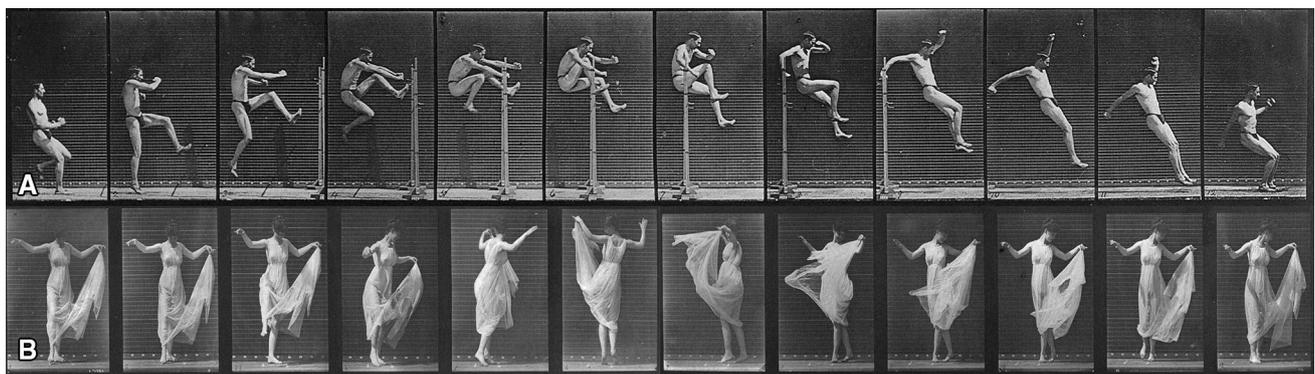
Art curator Linda Friedlander and retired dermatologist Irwin Braverman created a required medical school course at Yale University that hones student observational skills, a program so successful that it has spawned courses across the US, and a column for *CORR*<sup>®</sup> [7]. The “STEM to STEAM” program at Rhode Island School of Design, for example, teaches students how incorporating art and design drives innovation, and “flexible thinking, risk-taking and creative problem solving” across domains as diverse as healthcare to global warming [17].

Like the Rhode Island School of Design, the Institute of Design at Stanford University similarly poses “radical” collaborative teams to “take on the world’s messy problems together” [10]. Project teams immerse themselves in fieldwork, identify a need, attack a problem, and work through a solution. Storyboarding and storytelling are critical elements to articulating success.

Here, technology, business, and human values must converge with design innovation in order to craft a simple knee immobilizer from recycled parts or engineering an environmentally sustainable hospital [10]. These programs highlight the creative approach and renders specious any “art versus science” argument.

“The Art of Observation: Enhancing Clinical Skills through Visual Analysis” is Stanford’s offshoot of the Yale program. In this class, Stanford medical students examined stop-motion photographs of 19<sup>th</sup> century photographer Eadweard Muybridge [8], whose innovative approach to photography contributed considerably to the study of biomechanics. Through stop-motion photography, Muybridge captured quick-twitch movements of animals and humans that the human eye could not otherwise distinguish (Fig. 1A–B). The medical students at Stanford examined his photographs of an athlete jumping. They observed the camera angle, facial expression, and muscle activity, even noting a few images that seemed out of sequence. Later, they learned some of Muybridge’s techniques and rationale. Muybridge, ever-adamant that he was a scientist, not an artist, occasionally changed the image order to punctuate the story of locomotion as he wished to tell it—in much the same way animators exaggerate motion to, ironically, breathe more life into their subject. Careful observation may help us to correct the

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**Fig. 1A–B** (A) A typical sequence of Eadweard Muybridge’s groundbreaking stop-action photography of the human figure in motion: Male, athletic, and thinly clad. (B) The lower strip shows a woman dancing modestly clothed, expressing more art than science.

lapses we suffer in what one journalist has described as our “Age of Inattention” [6].

As physicians, we cannot indulge inattention. The big picture is paramount as the best scientific investigations combine both quantitative and qualitative components. Although disruptive to our evidence-based metrics mentality, the current move toward a volume-to-value model of healthcare, with quality its central focus, can potentially improve how we care for our patients [4]. A blend of the arts and sciences yields discovery and opportunity in medicine like a great musical duet—two voices, one story, equal partners. The husky velvet voice of Stevie Nicks commingled with the rasp of Don Henley singing “Leather and Lace” [13] comes to mind.

Women and other pioneers who break the mold across the sciences rift,

shift, and disrupt the status quo, creating innovation and, in hindsight, progress [20]. Like Muybridge, changing one’s perspective on an otherwise conventional image permits a new take on an old story. And like Bessie, Janis, and Aretha, such dynamism permits vision, passion, and power where scientific discovery becomes, well, a lesson in harmony.

## References

1. Aretha Franklin - Respect [1967] (Original Version) YouTube. <https://www.youtube.com/watch?v=6FOUqQt3Kg0>. Published Oct. 17, 2008. Accessed May 14, 2015.
2. Bernstein J. Not by bread alone: Shortcomings of the pay-for-performance approach. *Clin Orthop Relat Res*. 2014;472:405–409.
3. Bessie Smith (Nobody Knows You When You’re Down And Out, 1929) jazz legend [Video]. YouTube <https://www.youtube.com/watch?v=6MzU8xM99Uo>. Published June 4, 2009. Accessed May 14, 2015.
4. Burwell SM. Setting value-based payment goals—HHS efforts to improve U.S. health care. *N Engl J Med*. 2015; 372:897–899.
5. Festino J. Giants in orthopaedic surgery: Jacquelin Perry MD, DSc (Hon). *Clin Orthop Relat Res*. 2014;472:796–801.
6. Finn H. How to end the age of inattention. Available at: <http://www.wsj.com/articles/SB10001424052702303640104577436323276530002>. Accessed May 15, 2015.
7. Friedlaender GE, Friedlaender LK. Art in science: Enhancing observational skills. *Clin Orthop Relat Res*. 2013;471:2065–2067.
8. Genovese J. Honing the art of observation, and observing art. Available at: <https://med.stanford.edu/news/all-news/2015/03/honing-the-art-of-observation-and-observing-art.html>. Accessed May 15, 2015.

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9. Gonzalez HB, Kuenzi JK. Science, technology, engineering, and mathematics (STEM) education: A primer. Available at: <https://fas.org/sgp/crs/misc/R42642.pdf>. Accessed April 24, 2015.
10. Institute of Design at Stanford University. Our point of view. Available at: <http://dschool.stanford.edu/our-point-of-view/>. Accessed May 15, 2015.
11. Janis Joplin - Piece Of My Heart [Video]. YouTube <https://www.youtube.com/watch?v=7uG2gYE5KOs>. Published June 11, 2009. Accessed May 14, 2015.
12. Jolly, A. STEM vs. STEAM: Do the arts belong? Available at: <http://www.ed-week.org/tm/articles/2014/11/18/ctq-jolly-stem-vs-steam.html>. Accessed May 15, 2015.
13. Leather and Lace (Duet Demo with Don Henley). YouTube [https://www.youtube.com/watch?v=B38CFRsOL\\_0](https://www.youtube.com/watch?v=B38CFRsOL_0). Published May 26, 2010. Accessed May 15, 2015.
14. McKee J. Bonnie Simpson Mason, MD, honored with American Academy of Orthopaedic Surgeons diversity award. Available at: <http://www.aaos.org/news/aaosnow/apr15/youraaos4.asp>. Accessed May 15, 2015.
15. Nth Dimensions. About us. Available at: <http://www.nthdimensions.org/why/>. Accessed May 15, 2015.
16. Porucznik MA. Where are the women orthopaedists? Available at: <http://www.aaos.org/news/aaosnow/feb08/cover2.asp>. Accessed May 15, 2015.
17. Rhode Island School of Design. STEM to STEAM. Available at: [http://www.risd.edu/About/STEM\\_to\\_STEAM/](http://www.risd.edu/About/STEM_to_STEAM/). Accessed May 15, 2015.
18. Rock and Roll Hall of Fame. Women who rock: Vision, passion, power. Available at: <https://rockhall.com/exhibits/women-who-rock>. Accessed April 15, 2015.
19. STEAM Education. Available at: [http://www.steamedu.com/html/steam\\_about.html](http://www.steamedu.com/html/steam_about.html). Accessed May 15, 2015.
20. Teuscher DD. 2014 ABJS Earl McBride Lecture: Disruptive innovation: Orthopaedics in the 21st century. *Clin Orthop Relat Res*. 2015;473:789–793.
21. The Henry Ford Museum. Women who rock: Vision, passion, power. Available at: <http://www.thehenryford.org/events/womenwhorock.aspx>. Accessed April 10, 2015.
22. The Perry Initiative. Available at: <http://perryinitiative.org>. Accessed April 10, 2015.
23. Van Heest AE, Agel J. The uneven distribution of women in orthopaedic surgery resident training programs in the United States. *J Bone Joint Surg Am*. 2012;94:e9.