Anatomical Spatial Referencing in Medical Education

ALLISON K. CHATTERJEE
Marian University College of Osteopathic Medicine, Indiana
Adjunct, Department of Anatomy and Cell Biology
Indiana University-Purdue University Indianapolis (IUPUI)
Email: achatterjee@marian.edu

Medical education imposes a specific universal international vocabulary to describe anatomical structures, positions, and relationships upon the students. This vocabulary is consistent with the Terminologia Anatomica: International Anatomical Terminology and establishes a common, consistent language among medical professionals regardless of the individual’s country of origin or native language (Whitmore, 1999). This terminology is rooted in the Latin and Greek languages. Very rarely do students enter medical school with a background in these languages. Those that do typically have only had a basic medical terminology course, which is not a requirement for matriculation into medical school. Other courses in which they would be exposed to medical terminology – anatomy, histology, physiology, and neuroscience—also are not prerequisites to entering medical school. As a result, students are required to learn a new language for orienting the structures of the body in space while concurrently attempting to learn the clinically-relevant material necessary to be a competent physician.

This anatomical referencing system is based on a standardized orientation of the body—the anatomical position—in which a person is standing with their arms at their sides, palms facing forward, and toes facing forward. The terminology used to describe the spatial orientation of anatomical structures includes both relative and absolute terms. For example, a structure that is located above another structure can be described as either superior or more cranial. Superior would then be a relative term; while cranial would be considered an absolute term.

The extent to which students think about the spatial organization of the body in anatomical terminology versus their respective native languages is expected to vary significantly. One question of interest then is: What factors determine how quickly, effectively, and efficiently students adopt anatomical terminology and incorporate them into their schemas? Several potential factors include: (1) students’ familiarity with the language; (2) students’ level of experience; (3) students’ measured spatial ability; and (4) students’ enrollment in an osteopathic versus allopathic medical program.

Familiarity with Language
An individual’s native language could play a role in how well they are able to assimilate spatial anatomical terminology into their schemas. Those whose native language is most similar to Latin and Greek may have an easier time learning anatomical terminology. Those whose native language is vastly different from Latin or Greek might struggle to incorporate anatomical terminology into their schema. Instead, they might use their own language as the main reference frame, with the anatomical spatial language simply added on. This could be seen as someone redefining the word “medial” as “close to the middle.”
Novice vs Expert
Those students who have taken prior elective coursework that emphasizes Latin or Greek languages may be more adept at navigating anatomical terminology. Those who have taken prior courses in the anatomic disciplines—anatomy, histology, neuroscience, and embryology—may also have an advantage compared to novice learners who might be expected to rely on memorization of terms or the use of mnemonics in order to assimilate the new spatial terminology. Additionally, as students progress through their medical education from pre-clinical to resident to experienced physician, they encounter more complex examples of spatial anatomical relationships through clinical cases, patient interactions, and imaging studies (i.e., MRI, CT, ultrasound). Through these experiences it is assumed that they implicitly build upon their schema and more effectively incorporate anatomical terminology into that schema.

Spatial Ability
Those who score high on standardized assessments of spatial ability may be able to utilize new spatial terminology more effectively than those whose scores are low. A study investigating the differences between first-year medical students’ mental models found that students who scored high on the Purdue Visualization of Rotations Test consistently used more spatial anatomical terminology in their explanations than those students who scored low on the same test (Chatterjee, 2011). Replication of these results with additional spatial tests would provide further evidence that spatial ability is directly related to effective and efficient use of new spatial language.

Osteopathic vs Allopathic
Students attending osteopathic medical schools (schools granting a DO degree) might be able to apply anatomical terminology faster than those attending allopathic medical schools (schools granting an MD degree). Students at osteopathic medical schools receive additional hands-on training in osteopathic manual/manipulative medicine. This training reinforces understanding of the spatial relationships of anatomical structures. This kinaesthetic approach may lead to more robust schema that incorporate anatomical terminology.

These four factors are not likely to occur in isolation of each other. Different combinations of these factors might account for individual differences in students’ abilities to incorporate anatomical terminology in their understanding of anatomical spatial relationships.

The focus of this narrative was specifically on anatomical spatial referencing as opposed to clinical terminology in general. Although Terminologica Anatomica is considered a universal vocabulary, it is not static. Over time there have been changes and updates to accommodate new discoveries, common trends, and simplification. For example, a nerve in the lower extremity was previously known as the common peroneal nerve. This has recently been renamed the common fibular nerve to indicate its spatial location on the fibular/lateral side of the lower extremity. This can complicate communication between those who learned the old terms and those who have learned the new terms. Additionally, Terminologica Anatomica does not include all clinical terminology. Clinical terminology includes many eponyms, in which the name of a structure is derived from the name of a person. These terms are much less intuitive and do not follow a
systematic naming convention, as such it is less likely that clinical terminology has spatial applications.

References
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