Revista Española de Educación Médica

Reframing Clinical Reasoning in Radiology through Dual Process Theory in Medical Education.

Replantear el Razonamiento Clínico en Radiología a través de la Teoría del Procesamiento Dual en la Educación Médica.

Paola Ceciliana Añazco Moreira[1], Andy Hermógenes Luque Loor [2], Ariel Melis Sosa[3], José André Cedeño Orejuela[4-5]*.

Docentes de la Carrera de Medicina, Universidad San Gregorio de Portoviejo, Ecuador
[1] pcanazco@sangregorio.edu.ec, https://orcid.org/0009-0001-7499-6141
[2] ahluque@sangregorio.edu.ec, https://orcid.org/0000-0002-0381-3838
[3] amelis@sangregorio.edu.ec, https://orcid.org/0009-0009-0671-2723
[4] jacedeno2@sangregorio.edu.ec, https://orcid.org/0009-0000-4754-0643
[5] Docente de Posgrado en Maestría en Docencia en Ciencias de la Salud, Universidad Iberoamericana del Ecuador, jacedeno@doc.unibe.edu.ec, https://orcid.org/0009-0000-4754-0643

* Correspondencia: jacedeno2@sangregorio.edu.ec

Recibido: 8/6/26; Aceptado: 11/6/26; Publicado: 12/6/26

The growing demands of clinical reasoning in medical education have intensified the need for cognitive frameworks that explain how healthcare professionals make decisions under uncertainty. Dual Process Theory (DPT) provides a compelling model by distinguishing between intuitive and analytical reasoning processes (1-2); however, we contend that its integration into medical education remains insufficiently structured. This limitation restricts its potential to inform pedagogical strategies aimed at improving diagnostic accuracy and reducing cognitive errors.

At a conceptual level, DPT explains reasoning through the interaction of two systems: an intuitive, rapid, and experience-based process (System 1) and a slower, deliberate, analytical process (System 2) (1-2). We argue that this duality reflects the cognitive demands of clinical environments, where practitioners must balance efficiency with accuracy. In our view, developing the ability to transition effectively between these systems should be a core objective of medical training rather than an implicit outcome of experience.

Clinical contexts such as radiology clearly illustrate this interaction. Image interpretation often depends on pattern recognition processes aligned with System 1, particularly among experienced clinicians. When diagnostic uncertainty arises, a shift toward System 2 becomes necessary to ensure a more rigorous evaluation of findings (3-4). We emphasize that this interplay is not naturally optimized through exposure alone but requires intentional instructional design that explicitly targets both modes of reasoning.

A critical issue arises from the vulnerabilities associated with intuitive processing. Evidence indicates that a substantial proportion of diagnostic errors is linked to cognitive biases and heuristic shortcuts, including anchoring and availability effects (5-6). We assert that addressing these limitations requires more than reinforcing analytical reasoning; it demands cultivating metacognitive awareness and deliberate reflection as integral components of medical education.

From an educational standpoint, DPT offers a valuable foundation for designing interventions that strengthen clinical reasoning. We propose that exposure to diverse clinical cases, simulation-based training, and structured feedback can enhance intuitive expertise while reinforcing analytical

thinking (7-8). We also highlight the value of tools such as eye-tracking technologies, which provide insights into visual search behaviors and support improvements in diagnostic performance (9).

Integrating DPT into medical curricula contributes to aligning educational theory with clinical practice. Understanding how clinicians think (rather than focusing solely on knowledge acquisition) allows educators to design learning environments that better reflect real-world decision-making demands. This approach is particularly relevant in undergraduate training, residency programs, and simulation-based education.

At the same time, we acknowledge that DPT does not fully capture the complexity of clinical reasoning. The interaction between experience, context, and cognition is dynamic, and reducing decision-making to a dualistic framework may oversimplify this process (10). We therefore suggest that DPT should be applied as a complementary framework within a broader theoretical perspective.

In conclusion, we argue that DPT should be more explicitly integrated into medical education. Its capacity to bridge cognitive theory and clinical practice makes it a valuable tool for enhancing diagnostic reasoning and reducing errors. Rather than being treated as a theoretical construct, DPT should be recognized as a practical framework for preparing healthcare professionals to navigate uncertainty in clinical practice.

Funding: There was no funding.

Declaration of conflict of interest: The authors declare that they have no conflict of interest

Author contributions: Conceptualization: P.C.A.M.; A.H.L.L.; Data curation: P.C.A.M.; Formal analysis: A.H.L.L., P.C.A.M.; Investigation: P.C.A.M.; Methodology: A.H.L.L.; Project administration: P.C.A.M.; Software: A.H.L.L.; Supervision: A.H.L.L., J.A.C.O.; Validation: J.A.C.O., A.M.S., P.C.A.M.; Visualization: J.A.C.O., A.M.S., P.C.A.M.; Writing – original draft: A.H.L.L.; Writing – review & editing: A.H.L.L., J.A.C.O.

6. References.

1. Evans JS. Dual-processing accounts of reasoning, judgment, and social cognition. *Annu Rev Psychol*. **2008**, 59, 255-78. https://doi.org/10.1146/annurev.psych.59.103006.093629
2. Evans JS, Stanovich KE. Dual-Process Theories of Higher Cognition: Advancing the Debate. *Perspect Psychol Sci*. **2013**, 8(3), 223-41. https://doi.org/10.1177/1745691612460685
3. Djulbegovic B, Hozo I, Beckstead J, et al. Dual processing model of medical decision-making. *BMC Med Inform Decis Mak*. **2012**, 12(94). https://doi.org/10.1186/1472-6947-12-94
4. Van Der Gijp A, Webb EM, Naeger DM. How Radiologists Think: Understanding Fast and Slow Thought Processing and How It Can Improve Our Teaching. *Acad Radiol*. **2017**, 24(6), 768-771. https://doi.org/10.1016/j.acra.2016.08.012
5. Yoon SY, Lee KS, Bezuidenhout AF, Kruskal JB. Spectrum of Cognitive Biases in Diagnostic Radiology. *Radiographics*. **2024**, 44(7), e230059. https://doi.org/10.1148/rg.230059
6. Itri JN, Patel SH. Heuristics and Cognitive Error in Medical Imaging. *AJR Am J Roentgenol*. **2018**, 210(5), 1097-1105. https://doi.org/10.2214/AJR.17.18907
7. Leong JJ, Nicolaou M, Emery RJ, Darzi AW, Yang GZ. Visual search behaviour in skeletal radiographs: a cross-specialty study. *Clin Radiol*. **2007**, 62(11), 1069-77. https://doi.org//10.1016/j.crad.2007.05.008
8. Brams S, Ziv G, Hooge ITC, Levin O, De Brouwere T, Verschakelen J, Dauwe S, Williams AM, Wagemans J, Helsen WF. Focal lung pathology detection in radiology: Is there an effect of experience on visual search behavior? *Atten Percept Psychophys*. **2020**, 82(6), 2837-2850. https://doi.org/10.3758/s13414-020-02033-y
9. Pecaric M, Boutis K, Beckstead J, Pusic M. A Big Data and Learning Analytics Approach to Process-Level Feedback in Cognitive Simulations. *Acad Med*. **2017**, 92(2), 175-184.

https://doi.org/10.1097/ACM.0000000000001234

10. Monteiro S, Sherbino J, LoGiudice A, Lee M, Norman G, Sibbald M. The influence of viewing time on visual diagnostic accuracy: Less is more. *Med Educ*. **2024**, 58(7), 858-868. https://doi.org/10.1111/medu.15380