

Non-Conscious Detection of “Missed” Lung Nodules

Gregory J. DiGirolamo, Ph.D^{1,2}; Federico Sorcini, B.A¹; Leo Joskowicz, Ph.D³; Alexander Bankier, MD, Ph.D¹; & Max P. Rosen, MD, MPH¹

¹Department of Radiology, UMass-Chan Medical School, Worcester, MA, USA; ²Department of Psychology, College of the Holy Cross; Worcester, MA, USA; ³School of Computer Science, The Hebrew University of Jerusalem, Jerusalem, Israel

Finding a potentially cancerous nodule on a chest CT is a difficult visual search task that involves both conscious and non-conscious brain processes. Radiologists receive years of specialized training to enhance these processes. Yet, overall diagnostic error rates of ~30%^{1,2}, rising to as much as 50% for detection of lung nodules^{3,4}, are as high as they were six decades ago⁵. These failure rates may arise from the limits of conscious recognition. Using a novel paradigm to isolate non-conscious processes, here we show that non-conscious processes, in the absence of conscious recognition or consideration, are detecting lung nodules as indexed by the eye movements of the radiologists which demonstrate longer looking time and increased physiological arousal. Using solely these markers of non-conscious detection (and not the CT image or the radiologist’s own conscious report), machine learning can successfully localize 78% of the “missed” nodules. We anticipate these findings as a promising starting point to increase clinical diagnostic accuracy by tapping into these successful non-conscious brain processes.