Introducing the Special Series on 2D and 3D Imaging: Perspectives in Human and Model Observer Performance

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As medical imaging expands from 2D to 3D scanning technologies, it is important to understand how diagnostic information is represented and accessed – both perceptually and algorithmically – in images of different dimension. The historical emphasis on 2D images provides a foundation of evaluation methodologies and experimental findings that can be used as a reference for comparison with newer 3D approaches. The purpose of this special series is to explore this interface.

Anatomical knowledge and specialized visual skills, such as pattern recognition and efficient visual search strategies, are fundamental for the effective interpretation of medical images. However, it is not clear that the skills and techniques that lead to successful decision making in 2D imaging are the same as those that will lead to success in the reading of 3D images. This is true not only for human readers, but for computer-based "readers" as well. Algorithms developed for 2D images can fail when applied to 3D datasets. A limited set of studies to date have established that diagnostic features, human search patterns, and effects of reader expertise can change substantially between 2D and 3D images. Additionally, 3D volumetric images require a more complex display procedure to render 3D spatial relationships on a 2D monitor in a way that is most effective for the reader. Open questions in these areas and related topics have motivated us to focus new work in this area into a readily accessible series as a resource for building this field.

The objectives of the special series are to characterize the differences between the use of 2D and 3D imaging as it relates to understanding of human and computer decision-making processes. The relevant topics include – but are not limited to – visual search, image perception, observer performance, model observers, computer-aided detection, cognitive processes, deep and machine learning and image understanding.

The special series begins in this issue of the journal (see the articles "2-D CNN vs 3-D CNN for false-positive reduction in lung cancer screening" by Yu et al. and "Eye tracking reveals expertise-related differences in the time-course of medical image inspection and diagnosis" by Brunyé et al.). We welcome submissions across the spectrum of disease processes and imaging modalities focused on understanding theoretical and practical impacts of image dimension. To this end, we hope to stimulate research into the role of image dimension on perceptual and cognitive processes of decision makers in different areas of medical image interpretation.

Claudia Mello-Thoms received her joint PhD in 2001 from Rutgers University and the University of Medicine and Dentistry of New Jersey. She has worked at the University of Pennsylvania, University of Pittsburgh and University of Sydney, in Australia. In 2018 she joined the prestigious Image Perception laboratory at the Department of Radiology, University of Iowa. Her research interests are visual search, medical image perception and image understanding. She seeks to understand why errors occur in the reading of medical images, being these either radiological or pathological images. Recently she started using machine learning to develop applicatives to help radiologists and pathologists make fewer false positives and false negative decisions when reading breast images.

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Craig K. Abbey received his PhD in applied mathematics from the University of Arizona in 1998. He is currently a researcher in the Department of Psychological & Brain Sciences at UC Santa Barbara. His research interests focus on modeling human observer strategies for performing visual tasks in the presence of image noise and other degradations, and the assessment of medical imaging devices and image processing in terms of performance in diagnostic and quantitative tasks.

Elizabeth A. Krupinski is an experimental psychologist with research interests in medical image perception, observer performance, medical decision making, and human factors as they pertain to radiology and telemedicine. The goal of her research is to improve our understanding of the perceptual and cognitive mechanisms underlying the interpretation of medical images in order to reduce errors, improve training, and optimize the reading environment, thereby improving patient care and outcomes.