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EDITORIAL

Interdisciplinary team leader: the neuroradiologist's new role

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Over the last decades there is an increasing interest "in digging into" the vast amount of MRI data collected by modern scanners. In neuroradiology, the classic approach of looking at the images of different sequences, assigning qualitatively signal intensities to normal tissues or to disease processes, measuring dimensions and several other metrics, like relaxation times (T1, T2), diffusion tensor imaging scalars (FA, ADC, AD, RD), perfusion (CBV, CBF, MTT) and magnetisation transfer imaging (MTR) continues to represent the fundamentals of our everyday practice. However, the improvement of the MRI technology provides subtle information at a voxel level, undetected even by the most keen, expert neuroradiologic eye, waiting to find its way out. If we really want to take full advantage of our data, we must admit that neuroimaging has become not a "one man's show" but rather an interdisciplinary team reminiscent of a small orchestra consisting of neuroradiologists, computer scientists, medical physicists and engineers.

The first step to a successful performance of such an orchestra is to create a common language, understandable to all parties, to express clearly "what I need to know and why" and "what I can offer and which are the limitations". This requires continuous education and learning of the basic principles, methods and ideas of the other disciplines. As a conductor, you are not required to play all the organs in the orchestra, but you should be able to coordinate them and evaluate their fine tuning and output. In the United States National Institutes of Health (NIH) Roadmap for Medical Research, it is noted that interdisciplinary team science broadens the scope of investigation into biomedical problems, yields fresh and possibly unexpected insights, and gives rise to new inter-disciplines that are more analytically sophisticated [1]. According to the NIH Roadmap, the traditional divisions within health research can impede the pace of discovery.

There are numerous examples of the fruitful fusion of neuroradiology with other disciplines. Engineering for example has recently produced hybrid systems (PET/MRI, PET/CT), with potential to change medical imaging by providing combined anatomical-metabolic image information. Computer science has always been both a loyal servant and a driving force to radiology in all aspects of image reconstruction, visualisation, analysis and storage. Mathematics and informatics along with medical physics and biophysics have been able to provide detailed models of brain anatomy and function and extract information buried in noise or reveal complex relationships, hidden patterns and unexpected trends in the brain data. New fields (radiomics, connectomics) with their own bizarre creatures (textures, graphs, multivariate patterns, independent components) invade and challenge our conceptual framework. We strive to harness the power of the new tools, but we will never succeed alone. We need to reach out for help, to assemble a team that integrates information, techniques, perspectives, concepts, to advance fundamental understanding and solve problems whose solutions are beyond the scope of a single discipline or area of research practice.

Working alone is based on a common misconception that math and computers are never wrong, and you only have to buy or download a program and feed it with images to get the correct results. There are many reasons why this is not true. Devil is in the details and you need help from other disciplines to discover him. Never forget that both neuroimaging data and their analysis algorithms, despite their sophistication, remain essentially crude anatomical or physiological models of the human brain, the most complicated object in the known universe. They provide approximations of reality based on various assumptions and, although they are inherently wrong, we use them as extremely useful diagnostic and research tools. Our duty as neuroradiologists is to keep in mind these approximations and assumptions during our assessments.

Take for example the tractography maps every modern MRI scanner produces with a few mouse clicks. They are beautiful and impressive 3D representations of the white matter tracts but their production is based on the simplified ellipsoid model of probability for water molecule diffusion and on the streamline algorithm. Both provide a good approximation only in the case of large parallel dense fibers. Additionally, diffusion images have been acquired with specific intensity of the diffusion gradients, which restrict the detection window of the diffusion processes. Add on top of that susceptibility and eddy currents distortions, subject motion, noise effect on quantification, partial volume effects [2] and the initial enthusiasm for the colourful tractography maps will soon be tempered.

Every day neuroradiologists make hundreds of decisions impacting the well-being of their patients. Their job becomes increasingly challenging as the growing amount of images increases the workload, slows the reading time and undermines the diagnostic accuracy. New imaging technologies can alleviate the pressure and bring enormous benefits to the patients. They also present new opportunities to expand neuroradiologists' role as public health providers, but they require a remarkable transition in the working environment. A collaborative team can help them to face the new challenges, establish their pivotal role in the healthcare system, and provide faster, more efficient and more accurate interpretation services.

Contrary to the speculations that Artificial Intelligence might one day replace (neuro)radiologists, we believe that the only neuroradiologists whose jobs may be threatened are the ones who refuse to become collaborative interdisciplinary team leaders and embrace the new technologies. According to a popular quote: "We cannot direct the winds, but we can adjust our sails". It would benefit our careers but more importantly the lives of our patients. **R**

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