Introduction: In vivo proton magnetic resonance spectroscopic imaging (MRSI) has a proven track record as a research tool and shows clinical promise in a range of diseases including brain tumours [1, 2], stroke [3, 4], epilepsy [5, 6] and multiple sclerosis [7, 8]. To enable reliable clinical (diagnostic and longitudinal) use, the repeatability of the technique must be quantified. Whilst studies have quantified repeatability [9–16], it is imperative that the procedure is repeated for all scanners and institutions so as to account for differences in hardware, pulse sequences, etc. A study was, therefore, undertaken to quantify repeatability at our own institution.

Methods: MRSI was carried out using a 3.0 Tesla, whole-body Signa MRI Scanner (GE Healthcare, Milwaukee, WI, USA), a bird-cage head-coil and semi-automated higher-order shim optimisation. Eight healthy volunteers were scanned twice during the same examination, with shim settings and transmit/receive gains held constant. Informed consent was obtained in all cases. A 3D PRESS sequence was used with a 144 ms TE, a 1000 ms TR; a voxel over-sizing (OVERPRESS) factor of 1.3; a 12 x 12 x 8 cm FOV and 12 x 12 x 8 phase encode steps (1 ml nominal voxels). The region of interest ranged between 7 x 5 x 3 voxels and 7 x 5 x 5 voxels. Six outer-volume saturation (OVS) bands adjacent to voxel edges were employed along with four additional OVS bands to saturate artefactual signals arising from the frontal sinuses, the skull base and the mouth and naso-pharynx. Peak areas were quantified using the LCMModel package (Stephen Provencher, Ph.D, Oakville, Ontario, Canada) with SAGE/IDL (GE Healthcare, Milwaukee, WI, USA) as an interface. The NAA:choline peak area ratio was taken as the “n” value (giving non-constant repeatability limits), as shown in Figure 2b. The proportion of data lying between the repeatability limits in figures 2a and 2b are 95.1% and 94.4% respectively; thus proving that the calculated limits perform the desired function (acting as 95% confidence limits).

Conclusion: It has been shown that the measurement error for MRSI metabolite concentration ratios, as measured in the healthy human brain, can be proportional to the mean (for the common acquisition protocol used herein, at least). This means that simple repeatability limits (e.g. mean ± 1.96 standard deviation, the 95% confidence interval) may not be strictly applicable to the data, because the precision of the data changes with the mean. It has also been shown that an appropriate, well-known and trusted mathematical transformation of the data can ameliorate the problems associated with measurement error being proportional to the mean, thus permitting meaningful and robust estimates of (non-constant) repeatability limits to be calculated; limits which will be invaluable in permitting the robust clinical application of MRSI in the future.