Soft Skills – Communicating Information

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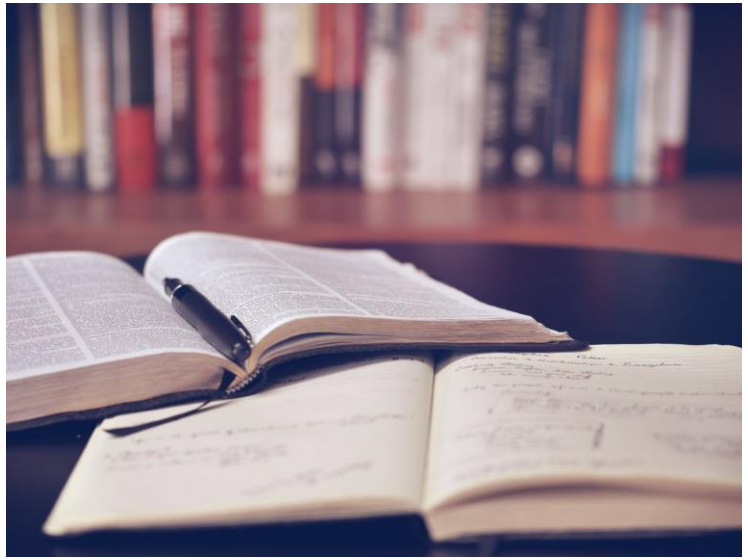
Introduction

One of the biggest aspects of working as a research scientist is sharing and presenting your work.

Today we will cover:

- **Planning and writing a research paper**
- **Writing and giving presentations**
- **Creating and presenting posters**

Research papers



Why write a research paper?

- Share your research with other interested people
- Convince them that your research is important, valid and relevant
- Critical for the evolution of science
- Aim to inform rather than to impress

Getting Started

Organise your ideas with paper and pencil.

- Simple planning. See page 5

- **Conduct your study and get your results!**
  - Obtained with a fixed experimental setup
  - Report all results

- **Results are the backbone of your paper.**
  - Figures, Tables etc. See page 6

- **Everything in your paper must be related to the data you present in your Results section.**

- **Write your Results section first.**
  - Make your figures
  - Describe your figures (and nothing else)

EXAMPLE OF HOW TO ORGANISE YOUR IDEAS

T_1 Mapping with Echo Planar Imaging with Keyhole

N.J. Shah, Seong Dae Yun

Introduction

- History of T_1 mapping
  - slow progress in research field
  - no progress in the clinic

D1 - Methods used (saturation recovery/inversion recovery)
- Haase
- Deoni
- MR finger printing

D2 - Accuracy and Precision
- Stress importance
- Most methods don't bother with a gold standard (phantom) and only report in vivo
- Often comparison is with a sub-standard method

D3 - Acquisition times
- Most methods us a few time points in the interests of speed and SR -> loss ½ dynamic range
- Those that use many time points are long
- Parallel imaging can help but with the usual disadvantages

D4 - Application Compatibility
- Motion artefacts are a big problem
- Healthy subjects okay
- Patients problematic
- Children – normally out of the question

D5 - T_1 Mapping with EPIK
- We attempt to address the following problems:
  - Long acquisition times
  - Motion artefacts through short/'single' short method
  - Demonstrate accuracy in phantoms (spec / imaging)
  - Compare with TAPIR in phantoms and in vivo

Discussion

D1 - Compare and contrast EPIK with other methods

D2 "

D3 - Now you can discuss AQ of EPIK with other methods for same resolution (~ 3D)
- Gain in speed leads to some problems
  - What are these (susceptibility artefacts)
- Can be combined with SR or IR (as in original EPI)
  - SR perhaps better at UHF because of lower SAR
- Just as EPI, EPIK compatible with parallel imaging
- At UHF EPIK has advantages over EPI
  - Shorter TE, especially at high res

D4 - Wider range of applications

D4 - Advantages/Disadvantages of EPIK T_1 Mapping

Conclusions

EXAMPLE OF HOW TO START PREPARING RESULTS

T1 mapping using TAPIR and EPIK (Phantom and *In vivo*)
- optimised protocol –

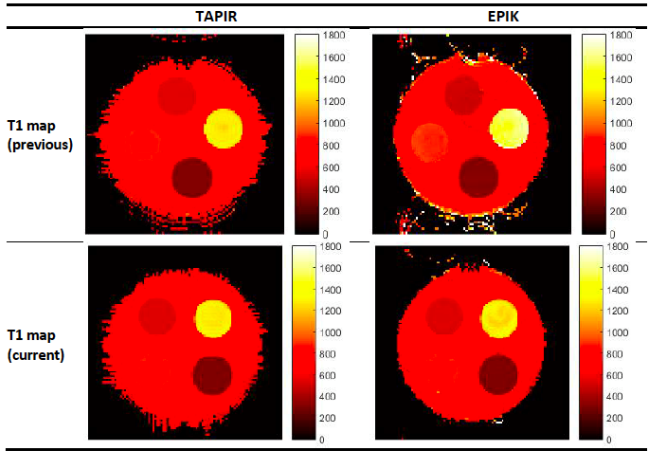
Seong Dae Yun

1. Imaging condition (phantom)

- Phantom with 4 small flasks in it
- FOV/Matrix size: 240 x 240 mm²/96 x 96 (2.5 x 2.5 mm²)
- Single slice with 2.5 mm thickness
- TR/TE/TI/tau = 47/25/20/2400 ms
- FA = 25°
- The above imaging conditions were kept identical for TAPIR and EPIK.

2. Fitting result (phantom)

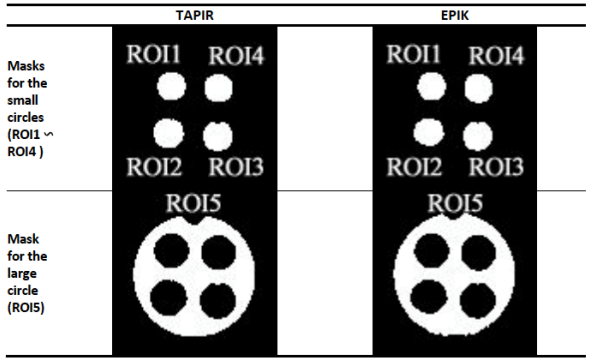
- There are still some remaining ghost artefacts in the EPIK case, but it looks better than the previous protocols.



3. Quantification (phantom)

- Masks were obtained for the four small circles and one large circle as shown below.

- The mask calculation was performed for each imaging method (TAPIR and EPIK), individually. This was due to the fact that as the image distortion level is different for TAPIR and EPIK, it is better to define the masks individually.



- For each ROI, the mean ± SD T1 value was computed. The results are listed in the table below.

	TAPIR	EPIK
ROI1	536.49 ± 2.52	535.16 ± 5.05
ROI2	860.13 ± 6.99	857.74 ± 7.42
ROI3	309.81 ± 4.98	309.75 ± 7.50
ROI4	1285.07 ± 18.89	1273.41 ± 35.02
ROI5	702.48 ± 14.33	705.75 ± 22.87

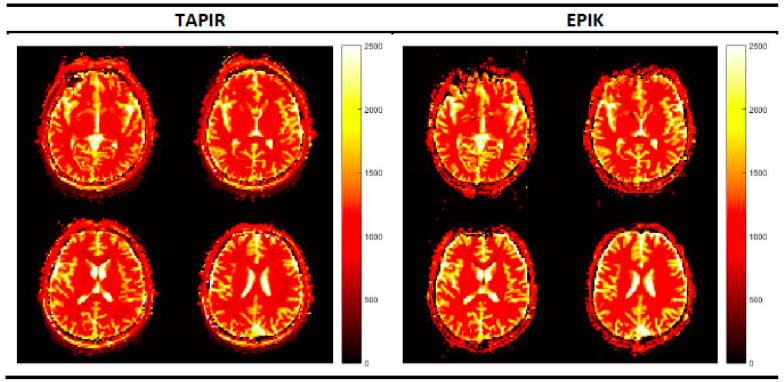
- As shown in the table, the estimated T1 values from EPIK are quite comparable to those from TAPIR. For each ROI, the standard deviation in EPIK is slightly larger than that in TAPIR.
- For the largest T1 value (ROI4), both cases show the largest standard deviation when compared to other ROIs.

4. Imaging condition (*in vivo*)

- One healthy subject
- FOV/Matrix size: 240 x 240 mm²/96 x 96 (2.5 x 2.5 mm²)
- 4 slices with 2.5 mm thickness
- **EPIK**: TR/TE = 60/25 ms
  TAPIR: TR/TE = 17.9/7.67 ms
- TI/tau = 20/2400 ms
- FA = 25°
- Optimal TR/TE were selected for each imaging case due to the time constraints of *in vivo* imaging.

5. Fitting result (*in vivo*)

- The below figure shows the obtained T1 maps for four slices.



6. Quantification (*in vivo*)

- Masks were obtained using the SPM12 routine for the white and grey matters.
- The mask calculation was performed for each imaging method (TAPIR and EPIK), individually.

Results

- Once you have gathered your results and analysed your data, you need to decide how to present it.
- What points you are trying to make and what do you want the data to show?
- Figures and tables illustrate and guide the reader through your research paper.
- Each type of data presentation has strengths and weaknesses - decide on the most appropriate for what you want to show.

Figure **Table** **Text**

Results

Make a choice between data display in figures or tables.

Most useful	Table	Figure
When working with	numbers	shapes
When concentrating on	individual data values	overall patterns
When accurate or precise actual values are	more important	less important

Figure adapted from: Cargill, M and O'Connor, P. **Writing Scientific Research Articles: Strategy and Steps, 1st edition**, Blackwell Publishing, 2009: p35

Results - Text

It is not necessary to repeat all the information shown in your tables or figures in words.

Only write sentences about the most important findings – then elaborate on their relevance to the 'bigger picture' in the Discussion.

A typical sentence in a results section will:

- **Highlight the important finding**
- **Tell the reader where they can find the results i.e. which figure or table**
- **Comment on (but do not discuss) the results**

Results – Use of Tense

- Use the past simple tense (either active or passive) to write about the study you completed, what you did and what you found.
- Use present simple to describe facts – things that are always true.
- Use past perfect to describe studies that have happened in the past but are important to what you are saying now.

Methods

The purpose of the Methods section …

To provide a detailed recipe so that other scientists can copy your study???

- Your paper should be rejected if it cannot be reproduced!!!

Your Methods section should:

- **Establish scientific rigor and credibility for your study.**
- **Provide enough information about what you did to enable the readers to decide if the results show what they claim to show.**

Methods

- **Your Methods section usually comes before your Results section.**
- **The two sections must link up.**

How to do that?

- **Use matching subheadings in both sections.**
- **Use introductory phrases or sentences that directly link the aims and results:**

In order to assess the achievable B0 homogeneity, the selected protocol included acquisition of both static and dynamic field maps using a 2D multi-echo, gradient-echo sequence with monopolar readouts, TE = [4, 5, 6, 8, 12] ms and TR = 540 ms.

Introduction

Now you have your Results and Methods sections … it's time for the Introduction.

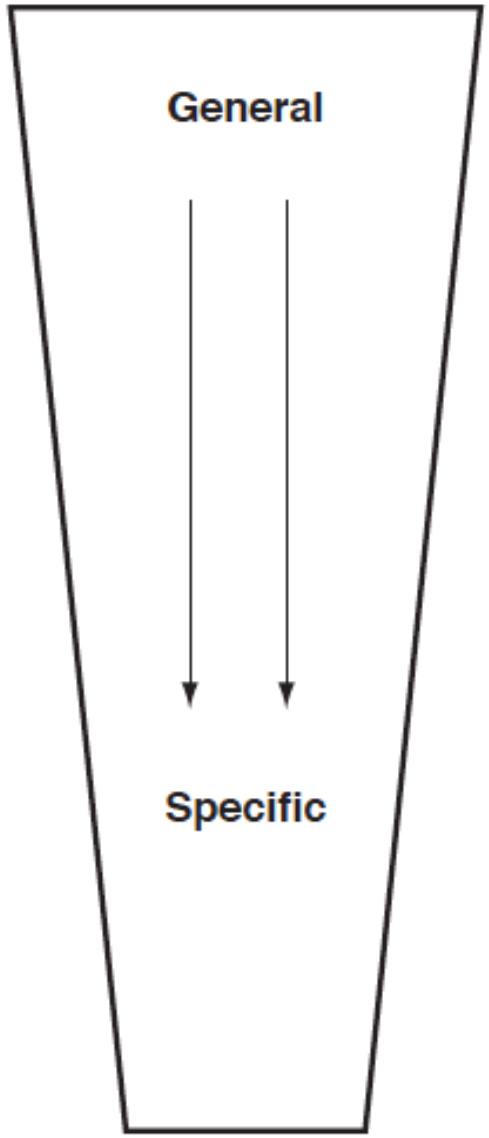
Your Introduction is particularly important as it places your research in the context of previous contributions.

Apart from the Abstract, it is probably where most people will start reading. It should:

- **Reflect the things you want to discuss later.**
- **Describe the state-of-the-art (including your own work)**

The last paragraph should outline what you are going to present, that goes beyond the state-of-the-art.

Introduction – The Flow



1. Statements about the field of research to provide the reader with a setting or context for the problem to be investigated and to claim its centrality or importance.
2. More specific statements about the aspects of the problem already studied by other researchers, laying a foundation of information already known.
3. Statements that indicate the need for more investigation, creating a gap or research niche for the present study to fill.
4. Statements giving the purpose/ objectives of the writer's study or outlining its main activity or findings.
5. Optional statement(s) that give a positive value or justification for carrying out the study.

Figure adapted from: Cargill, M and O'Connor, P. **Writing Scientific Research Articles: Strategy and Steps, 1st edition**, Blackwell Publishing, 2009: p42

Discussion

The purpose of your Discussion is to clearly link the points you raised in your Introduction with your results.

If in doubt, check back. If you didn't mention it in your Results or Introduction don't put it in your Discussion.

DO NOT simply repeat the information unnecessarily.

If you are going off the point, redraft!

Do not speculate! Everything you say should be backed up by your results and not those from others!

Discussion – What to Include

- A reference to the main purpose or hypothesis of the study.
- A restatement or review of the most important findings in order of their significance

  - say whether they support the original hypothesis and whether they agree with the findings of other researchers.
- Explanations/speculations for the findings, supported by relevant literature.
- Limitations of the study
- Implications of the study (what the results mean in the context of the broader field).
- Recommendations for future research and/or practical applications.

Adapted from: Cargill, M and O'Connor, P. **Writing Scientific Research Articles: Strategy and Steps, 1st edition**, Blackwell Publishing, 2009: p56

The Title

Provide as much detail as possible but be concise and relevant.

Place the most important words at the start of your title.

Perfusion weighted imaging using combined gradient- /spin-echo EPIK: Brain tumour applications in hybrid MR-PET

Ketamine-Treatment During Late Adolescence Impairs Inhibitory Synaptic Transmission in the Prefrontal Cortex and Working Memory in Adult Rats.

The Role of Aberrations in the Immune-Inflammatory Response System (IRS) and the Compensatory Immune-Regulatory Reflex System (CIRS) in Different Phenotypes of Schizophrenia: the IRS-CIRS Theory of Schizophrenia.

The Abstract

Possibly the only bit some people will read …

This is where you provide a concise summary of your research.

You should include:

- **The primary activity and purpose of your study.**
- **A brief description of your most important results.**
- **A short conclusion of your work including why it is important and relevant to the field.**

This is the bit that will ‘sell’ your paper.

Getting it published …

Snapshot of an example of a response to reviewers.

Peer review can be slow but is essential for validating research.

Reviewer #1

Summary:

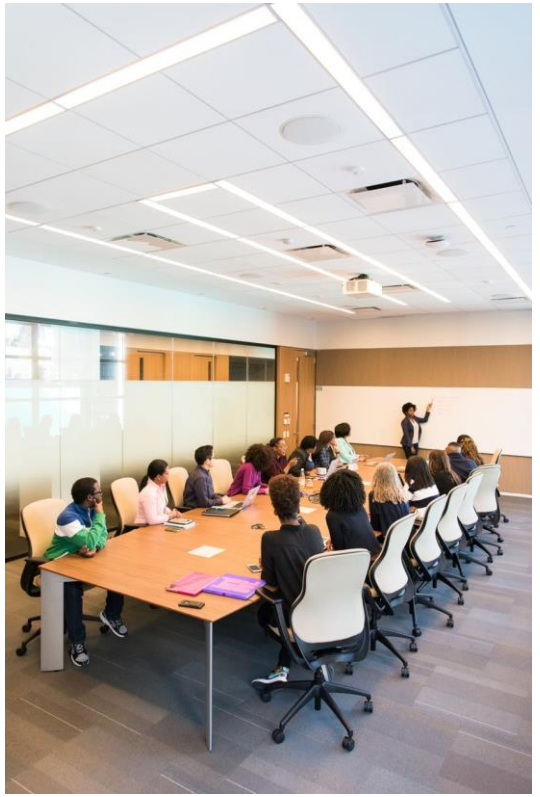
This manuscript presents an EPI keyhole approach to data acquisition for high resolution fMRI applications. First, the authors optimize both standard EPI and EPI keyhole sequences for high resolution scanning within the constraints of fixed TR and TE. The two sequences are evaluated in terms of susceptibility artifacts, fMRI metrics from a block designed visual activation task, and image blurring. Second, the authors investigate temporal autocorrelation behaviour using data acquired from a standard, lower resolution, EPI sequence that is reconstructed in ways to mimic standard EPI, mutli-shot EPI, and EPI keyhole. In the first set of results, the authors show that the high resolution implementation of the EPIK sequence achieves both improved resolution and reduced susceptibility artifacts; has comparable performance in terms of t-score metrics for large spatial areas of activation; and possibly improved performance in t-score metrics for small regions of activation. In the second set of results, the authors show that the EPIK sequence has slightly increased levels of temporal autocorrelation compared to standard EPI, but significantly less than multi-shot EPI.

Major comments:

1. **Most fMRI data acquisition schemes do not vary from one image volume to the next in order to prevent artifacts that are structured in time – i.e. artifactual signal that has power in the low frequency range and could confound the BOLD signal. The proposed EPIK method varies in which ky lines are acquired with a period of three image volumes. At a TR of 3 seconds, this 9 second periodicity corresponds to 0.11 Hz, which is within the range of expected BOLD signal changes depending on the stimulation paradigm. It would be good if the authors could address this potential limitation, at the very least in the discussion section, but ideally with data. For example: can the sequence be used for resting state fMRI studies given that this problem might induce spurious temporal correlations? Results are only shown for a simple block design task where most of the expected BOLD signal power is at very low frequency, but what about event related task designs? If you look at the fft of the time series, are there regions that show significant signal power around 0.11 Hz?**

   - The reviewer's points are discussed in the 'Discussion' section, which describes the possibility of applying EPIK to resting state fMRI and event related task fMRI.
   - In the revised manuscript (last paragraph of the 'Discussion' in page 31), the original sentence, "Additionally, any type of functional study should profit from the higher effective temporal resolution of EPIK.", has been changed to "Additionally, the present work employs a block-paradigm where the period of haemodynamic response changes was 18 seconds (0.056 Hz), meaning that the changes of functional signals is quite smooth. In resting state fMRI, the target functional signals are also relatively low frequency fluctuations (< 0.1 Hz) [34]. Therefore, it can be expected that the EPIK method can be also deployed in resting state fMRI without any further consideration on the temporal correlations. However, more detailed performance evaluation of EPIK for resting state fMRI is required in future studies. In this work, the employed block-paradigm has a slower haemodynamic response changes than the typical resting state fMRI. However, this can be faster by, for instance, applying a shorter TR. In this case, a reduced slice coverage is expected, but, as already mentioned, this issue can be effectively overcome with the integration of the multi-

Giving Presentations



There are many different types of presentation.

Unlike a research paper, giving a presentation is not so rigid in its construction.

It can be helpful for planning your research paper.

Some main points to consider when presenting a study:

- **The primary purpose of your study**
- **A brief description of your most important results**
- **A short conclusion of your work including why it is important and relevant to the field**

Giving Presentations - Time

There is never enough time ...

Carefully plan what you want to say

Use the ‘notes’ section on the slide to write what you want to say – pressure makes you forget

Speak slowly and clearly

Engage with your audience

Make sure you leave time for questions

Giving Presentations – Your Slides

- Keep your slides neat and easy to read.
- Chek you’re slids for typos.
- Use relevant figures and tables that the audience can see/read
- Use colour for emphasis – but check it shows up
- If you don’t talk about it – delete it

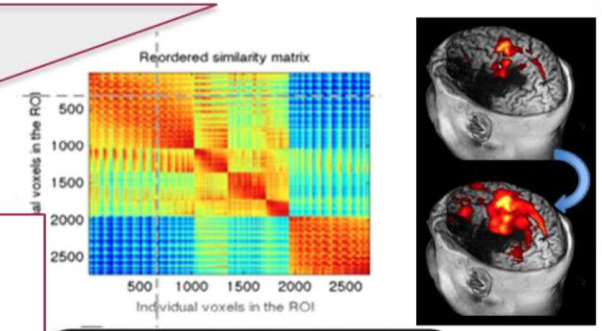
EXAMPLE OF A “BAD” SLIDE

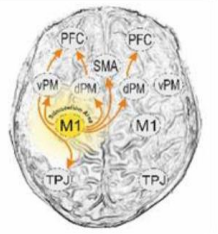
Program 2 Topic 5 | Objectives & Challenges

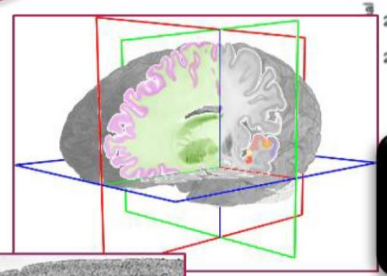
Brain complexity @ multiple levels

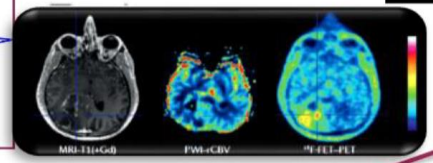
Simulation-Lab
Jülich supercomputers
Visualization
Big Data analytics
Machine learning

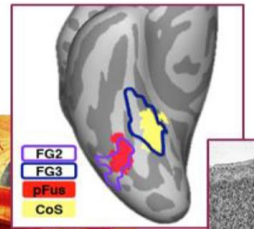
BIG DATA ANALYTICS & SIMULATION

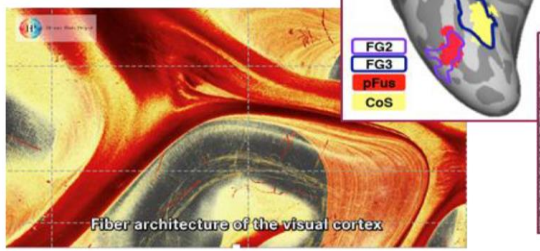


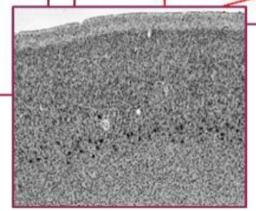


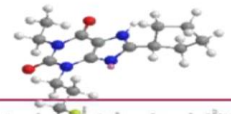


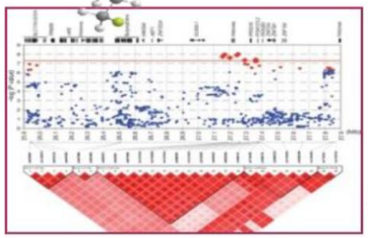


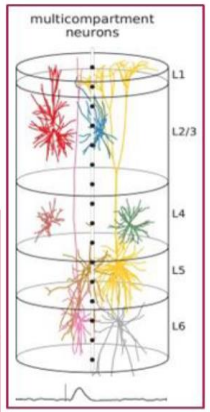


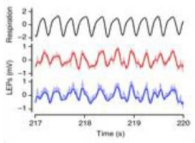








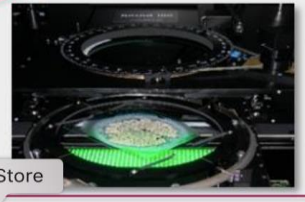




Multiscale in space and time, multimodal

9.4 T MR-PET
3 T MR-PET
3T & 7T MR
Electron microscopy
9.4 T animal MR
Tracer development
Radiopharmacology
3D Polarized Light Imaging
High-throughput microscopical Imaging
Atlasing

NEUROIMAGING



App Store

Giving Project Presentations – What to put where

1. Title your name and affiliations etc.
2. Give a brief outline of what you are going to talk about
3. Provide background and motivation for the project
4. Possibly discuss related work
5. What you did - methods
6. What you found - results
7. Summarise your findings in terms of your aims and the bigger picture
8. Conclusions, thanks and questions

Giving Presentations

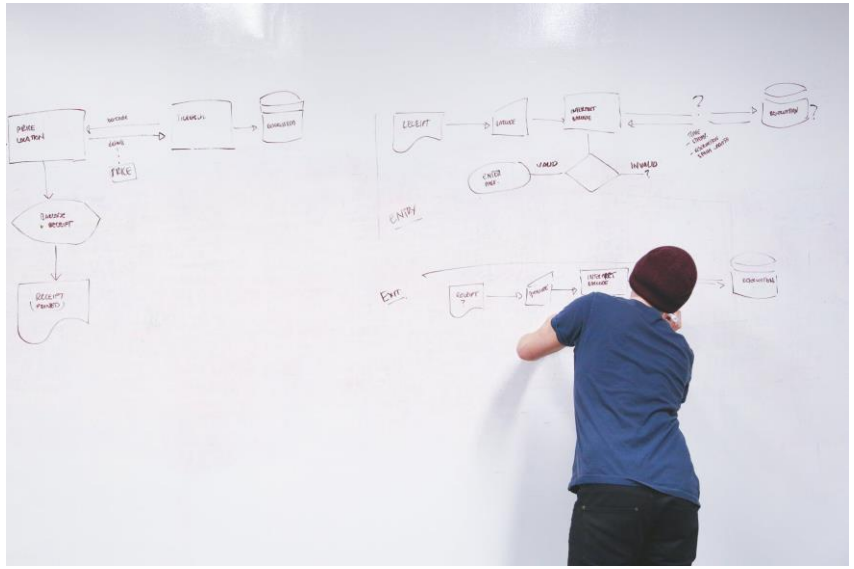
PRACTISE

Learn from peer-to-peer support and feedback

Posters

- Are different to presentations and research papers
- Aim to give a snapshot of your work
- Are intended to open dialogue or collaboration
- Make people want to find out more about your work

Posters - Planning



Decide on the purpose of your poster.

Will you be on-hand to explain your poster?

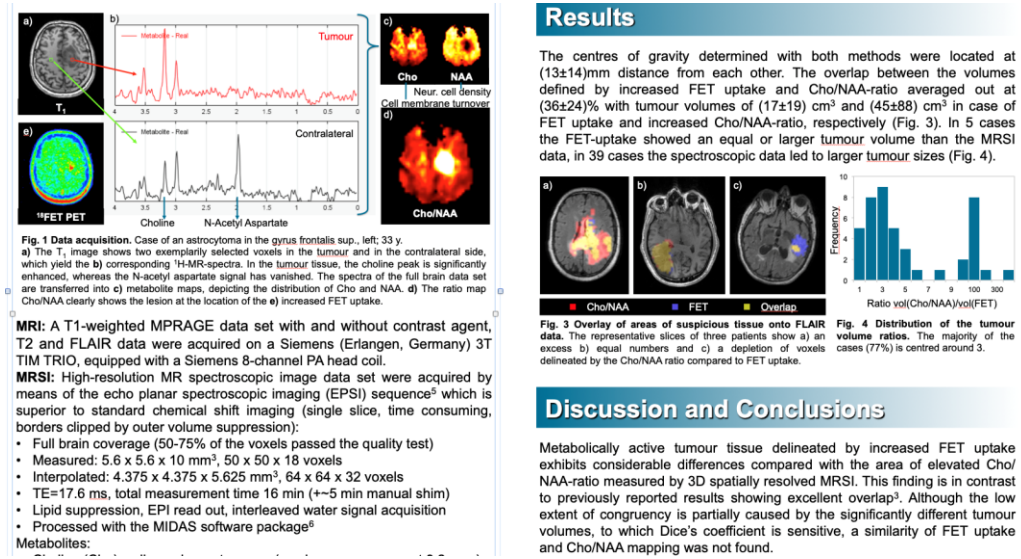
How can you get your message across quickly and effectively?

Layout – make it clear, logical, concise.

Posters

“Bad” poster

- Information overload!
- Writing and pictures too small
- Includes unnecessary data
- Badly organised and difficult to follow
- Fails to include your contact details



Tumour
Contralateral
Cho
NAA
Neur. cell density
Cell membrane turnover
Cho/NAA
^{18}FET PET
Choline
N-Acetyl Aspartate

Fig. 1 Data acquisition. Case of an astrocytoma in the gyrus frontalis sup., left; 33 y. **a)** The T_1 image shows two exemplarily selected voxels in the tumour and in the contralateral side, which yield the **b)** corresponding ^{1}H-MR-spectra. In the tumour tissue, the choline peak is significantly enhanced, whereas the N-acetyl aspartate signal has vanished. The spectra of the full brain data set are transferred into **c)** metabolite maps, depicting the distribution of Cho and NAA. **d)** The ratio map Cho/NAA clearly shows the lesion at the location of the **e)** increased FET uptake.

MRI: A T1-weighted MPRAGE data set with and without contrast agent, T2 and FLAIR data were acquired on a Siemens (Erlangen, Germany) 3T TIM TRIO, equipped with a Siemens 8-channel PA head coil.

MRSI: High-resolution MR spectroscopic image data set were acquired by means of the echo planar spectroscopic imaging (EPSI) sequence[5] which is superior to standard chemical shift imaging (single slice, time consuming, borders clipped by outer volume suppression):

- Full brain coverage (50-75% of the voxels passed the quality test)
- Measured: 5.6 x 5.6 x 10 mm^3, 50 x 50 x 18 voxels
- Interpolated: 4.375 x 4.375 x 5.625 mm^3, 64 x 64 x 32 voxels
- TE=17.6 ms, total measurement time 16 min (+~5 min manual shim)
- Lipid suppression, EPI read out, interleaved water signal acquisition
- Processed with the MIDAS software package[6]

Metabolites:

Results

The centres of gravity determined with both methods were located at (13±14)mm distance from each other. The overlap between the volumes defined by increased FET uptake and Cho/NAA-ratio averaged out at (36±24)% with tumour volumes of (17±19) cm^3 and (45±88) cm^3 in case of FET uptake and increased Cho/NAA-ratio, respectively (Fig. 3). In 5 cases the FET-uptake showed an equal or larger tumour volume than the MRSI data, in 39 cases the spectroscopic data led to larger tumour sizes (Fig. 4).

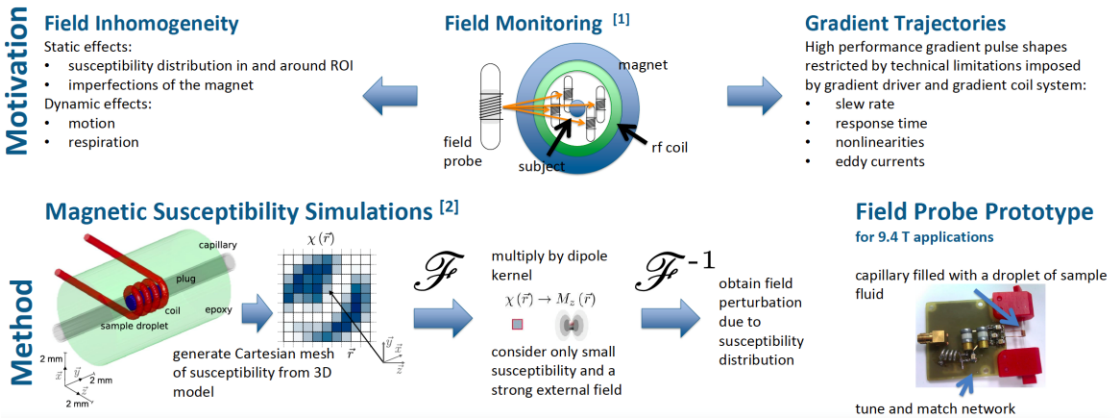
Cho/NAA
FET
Overlap
Frequency
Ratio vol(Cho/NAA)/vol(FET)

Fig. 3 Overlay of areas of suspicious tissue onto FLAIR data. The representative slices of three patients show a) an excess b) equal numbers and c) a depletion of voxels delineated by the Cho/NAA ratio compared to FET uptake.

Fig. 4 Distribution of the tumour volume ratios. The majority of the cases (77%) is centred around 3.

Discussion and Conclusions

Metabolically active tumour tissue delineated by increased FET uptake exhibits considerable differences compared with the area of elevated Cho/NAA-ratio measured by 3D spatially resolved MRSI. This finding is in contrast to previously reported results showing excellent overlap[3]. Although the low extent of congruency is partially caused by the significantly different tumour volumes, to which Dice's coefficient is sensitive, a similarity of FET uptake and Cho/NAA mapping was not found.



Motivation

Field Inhomogeneity
Static effects:
- susceptibility distribution in and around ROI
- imperfections of the magnet

Dynamic effects:
- motion
- respiration

Field Monitoring [1]
magnet
field probe
rf coil
subject

Gradient Trajectories
High performance gradient pulse shapes restricted by technical limitations imposed by gradient driver and gradient coil system:
- slew rate
- response time
- nonlinearities
- eddy currents

Method

Magnetic Susceptibility Simulations [2]
capillary
plug
coil
epoxy
sample droplet
$\chi(\vec{r})$
generate Cartesian mesh of susceptibility from 3D model
$\mathcal{F}$
multiply by dipole kernel
$\chi(\vec{r}) \rightarrow M_z(\vec{r})$
consider only small susceptibility and a strong external field
$\mathcal{F}^{-1}$
obtain field perturbation due to susceptibility distribution

Field Probe Prototype
for 9.4 T applications
capillary filled with a droplet of sample fluid
tune and match network

“Good” poster

- Clear layout
- Easy to read without a magnifying glass
- Uses pictures and diagrams rather than complicated text
- Uses colour and graphic elements

Conclusions

Whatever way you share your research and ideas:

- **Plan carefully.**
- **Stick to the point.**
- **Embrace feedback from others.**
- **Look to experts in the field to see how they do it.**

Communication

- **Science is a community.**
- **Being able to express yourself and present your ideas successfully is crucial for professional development.**
- **Effective communication supports collaboration and future projects.**