# Understanding human-AI interaction in medical imaging: Moving towards 'appropriate reliance'

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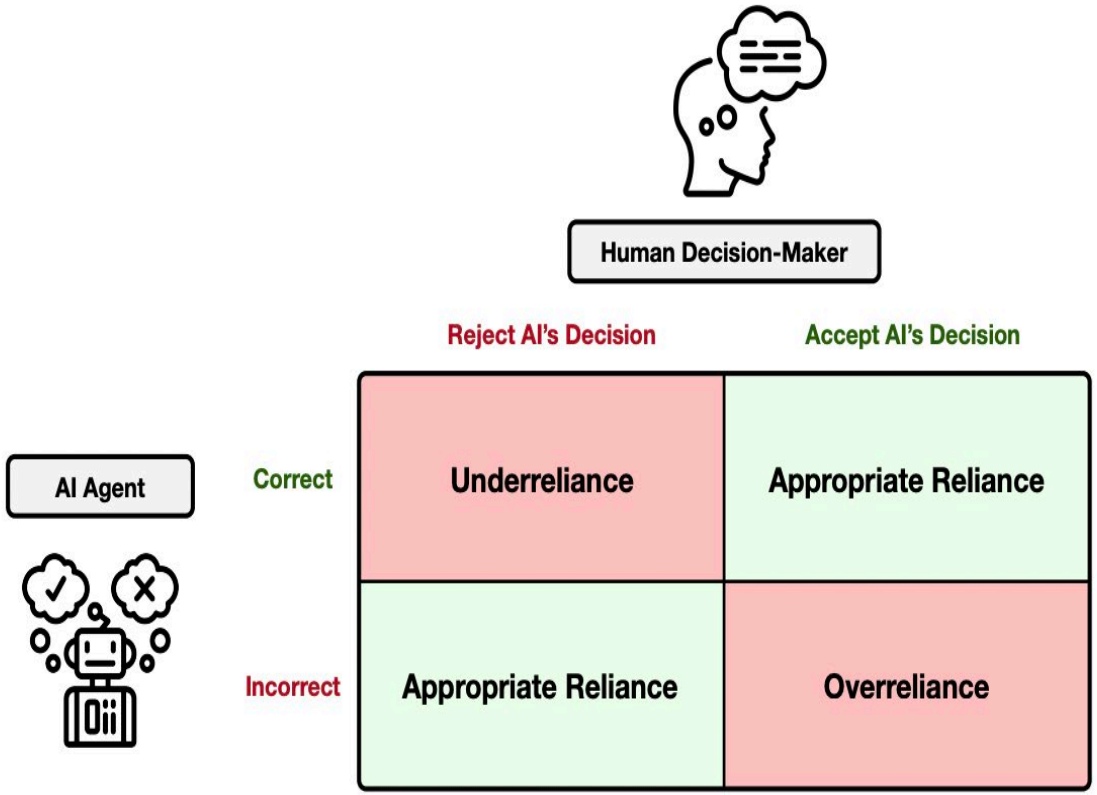


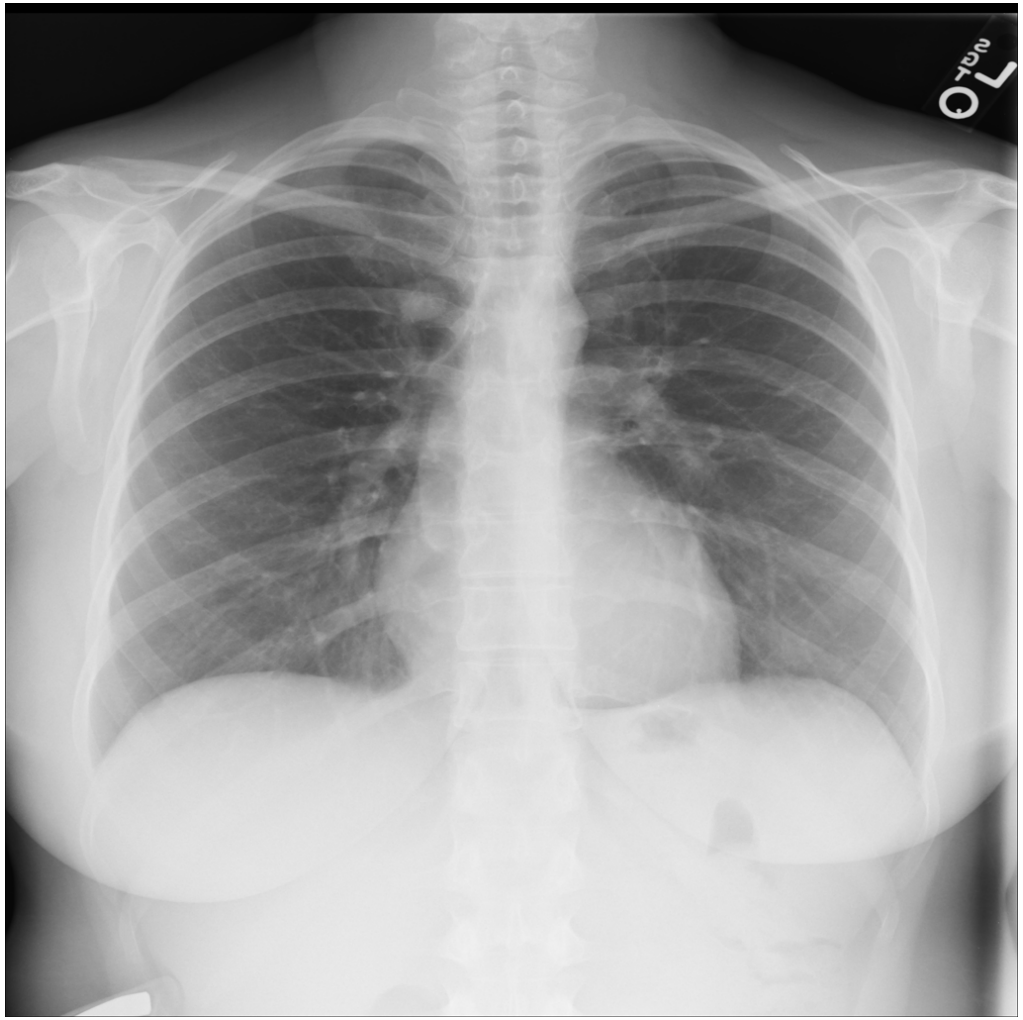

# What is appropriate reliance and why is it important?

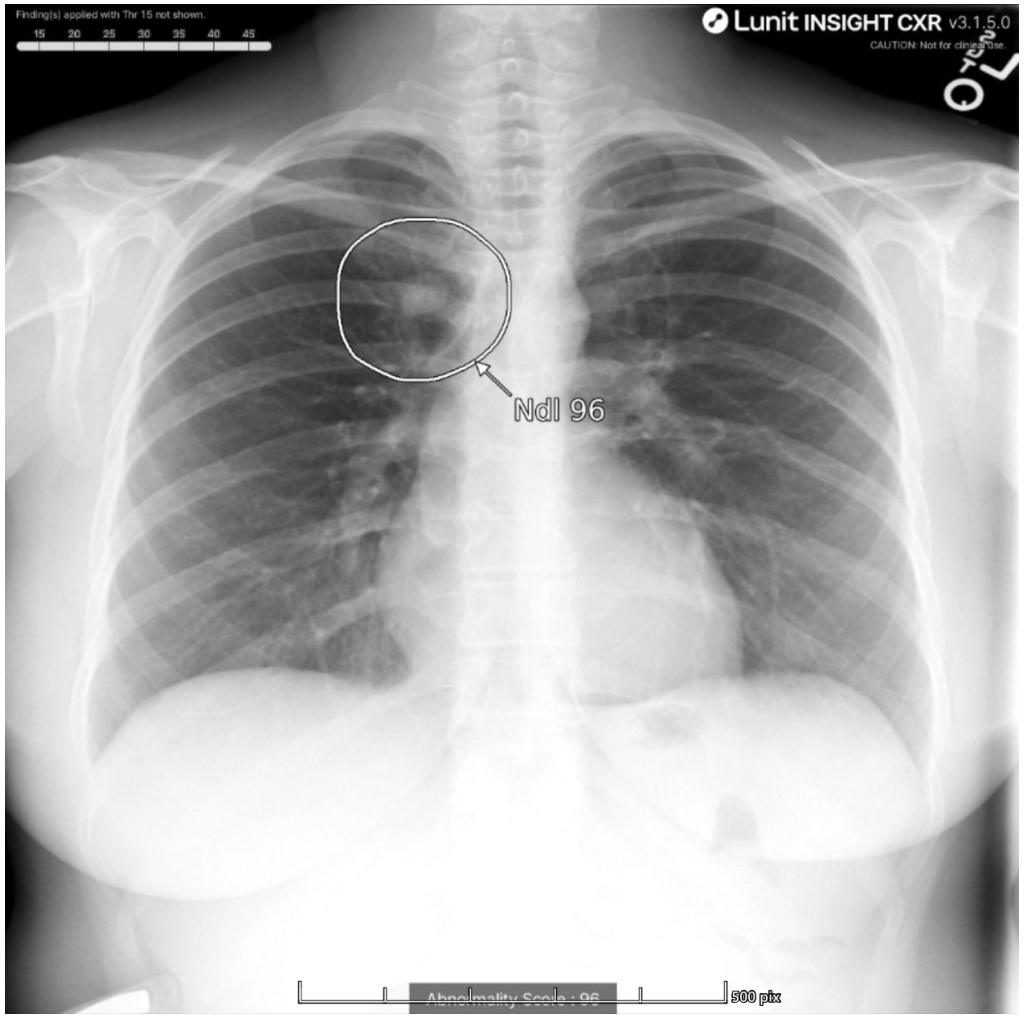
- *'the human capability to differentiate between correct and incorrect AI advice and to act upon that discrimination'* (Schemmer *et al.*, 2022)
- Over-reliance may lead to two types of error- errors of commission and/or errors of omission (Mosier and Skitka, 1996)
- Under-reliance means that performance will never change! (Reverberi *et al.*, 2022)

# Experiment one: The impact of observer experience and attitudes towards AI technology upon observer performance with AI during a pulmonary nodule detection task: An eye tracking study

# Method

- 11 year 1 radiography students, 13 year 3 radiography students and 6 reporting radiographers
- Within-subjects design- without/with AI
- The test bank comprised of 30 CXRs at a 50% disease prevalence rate. Each diseased image contained one pulmonary nodule
- All images were analysed by Lunit Insight CXR. AI sensitivity was 87% and it produced a total of 17 FPs (Average of 0.57 FPs per case)
- Participants had to localise any suspected nodules with a mouse click and had to provide a confidence rating from 1-5 for each case (1= definitely no nodule, 5= definite pulmonary nodule)
- Participants were not given any specific instructions regarding how to use AI but were informed that they could access AI findings at any point and could make their decisions independently
- Prior to participation in the experiment, observers answered a survey to ascertain their attitude towards AI using a subset of positive and negative statements from the 'General Attitudes to Artificial Intelligence' questionnaire (Schepman and Rodway, 2020)
- RJafroc and SPSS used for data analysis




Finding(s) applied with Thr 15 not shown.
15 20 25 30 35 40 45
Lunit INSIGHT CXR v3.1.5.0
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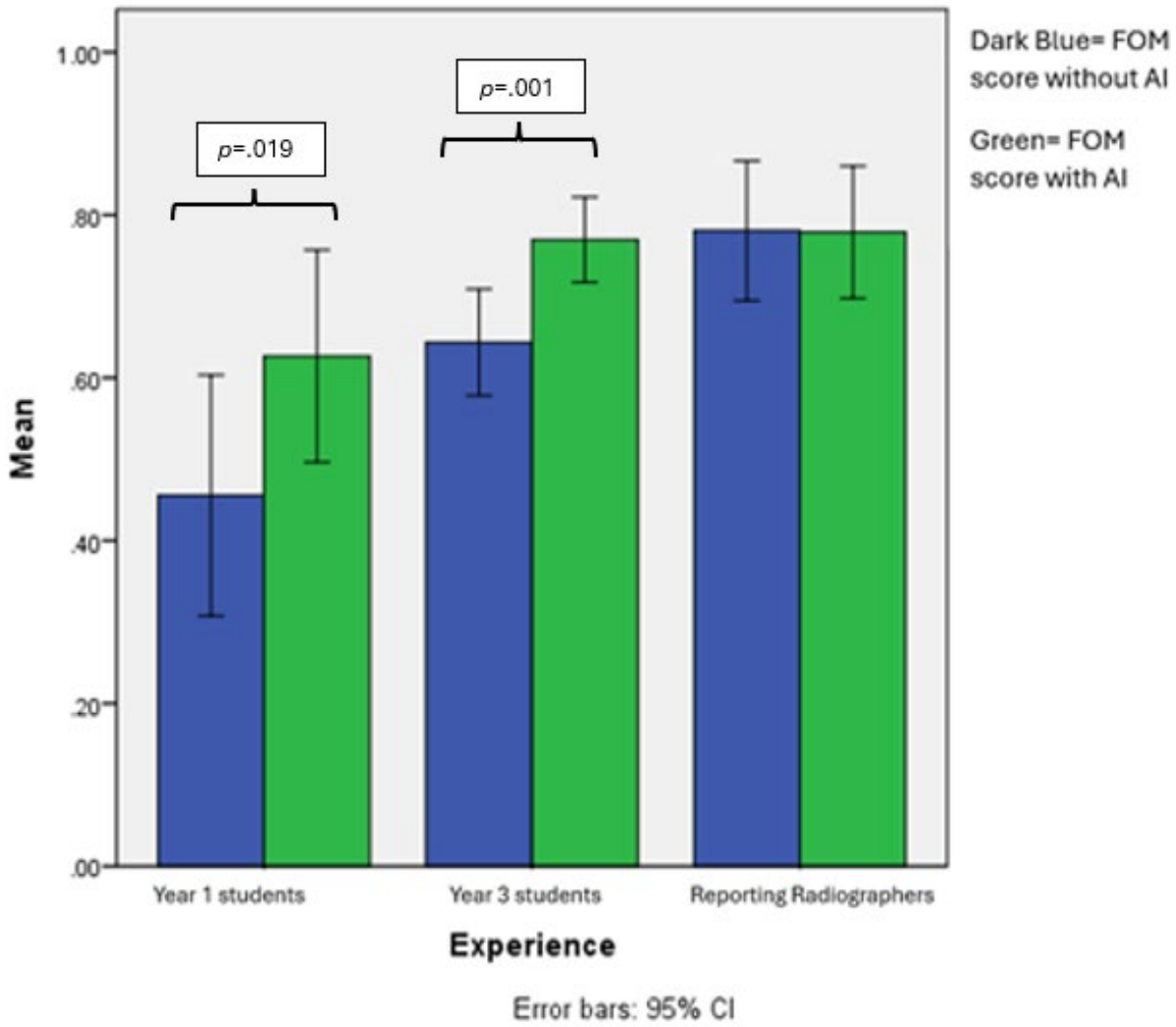
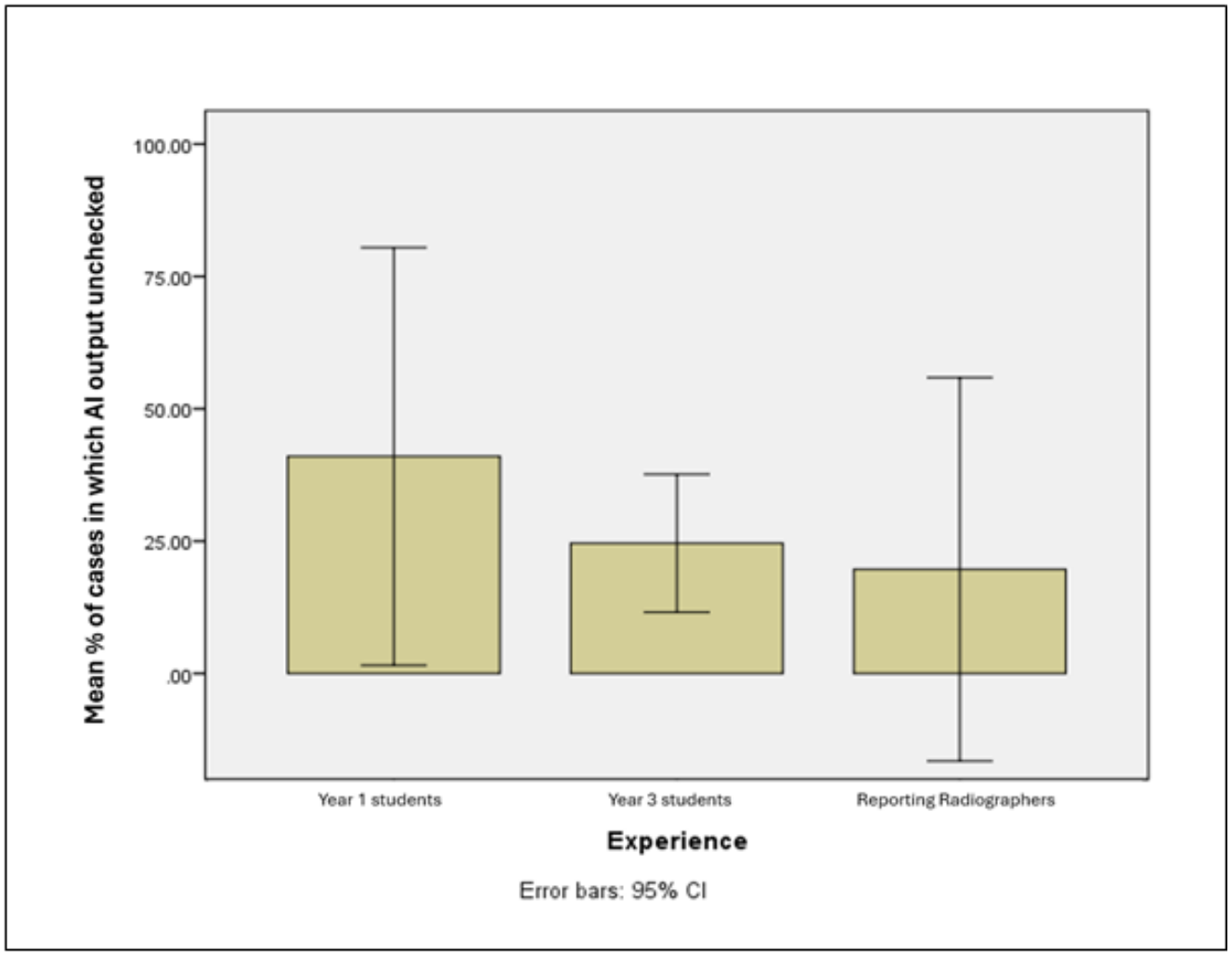


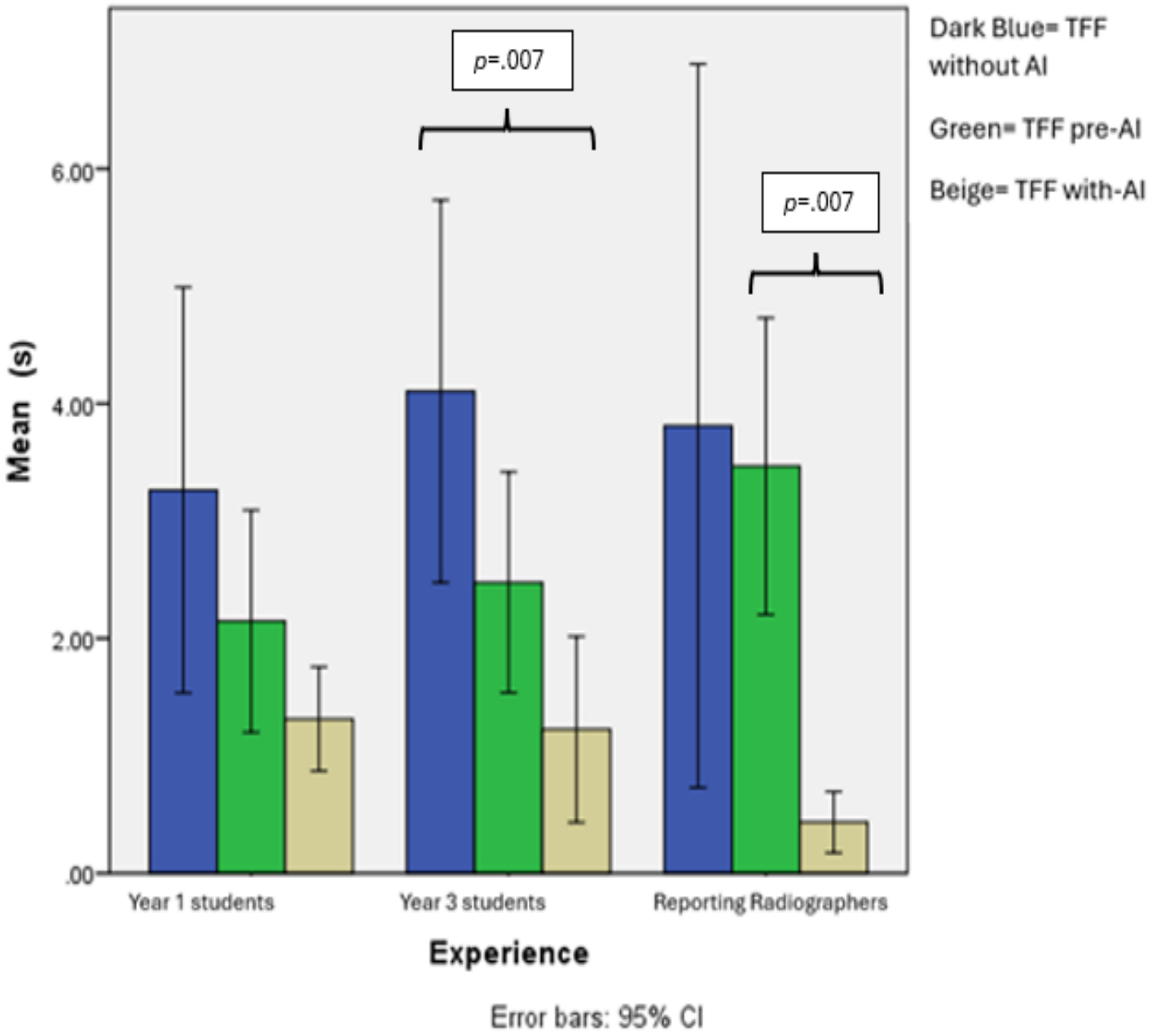

# Results- Figure of Merit (FOM)

- Figure of Merit score represents the probability that a lesion (nodule) is rated higher than the highest rated non-lesion on a normal image (Chakraborty and Berbaum, 2004)
- Mean FOM without AI= 0.60, mean FOM with AI= 0.72 ($p$=.001)
- Year 1 students had the greatest increase in mean FOM with AI (+0.17, $p$=.019), no change in the performance of reporting radiographers.
- Year 3 students were the only group in which all observers experienced an increase in FOM with AI




# Interaction with AI

- 63% of all participants opted to check AI output in 100% of cases
- Trend towards increased engagement with AI output with increasing levels of experience. However, the difference between groups was non-significant ($p$=.167)
- Not checking AI had limited impact upon performance

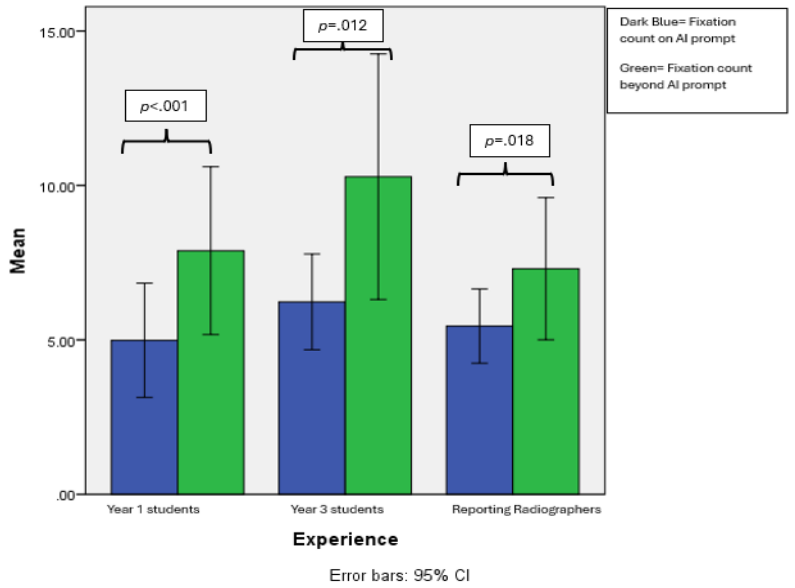


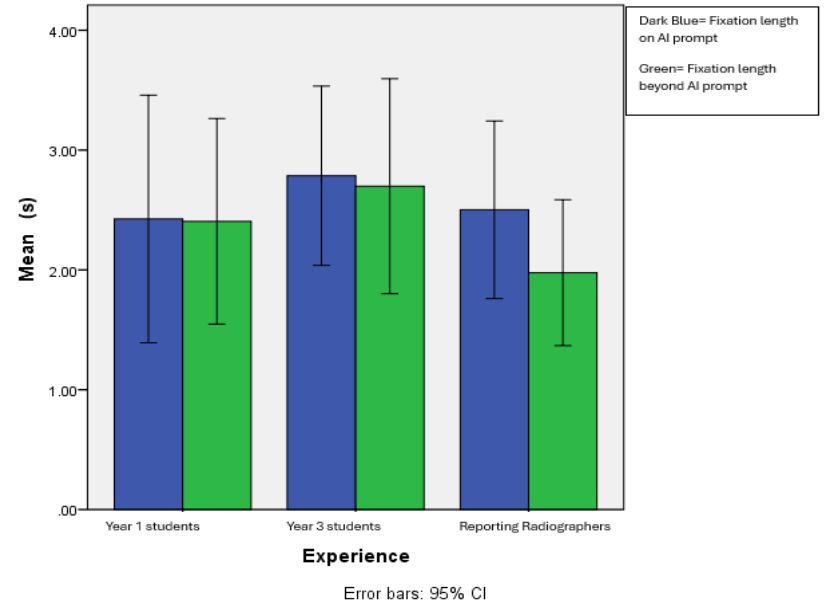

# Eye tracking metrics- Time to First Fixation (TFF)

- TFF- time from image onset to first fixation on nodule
- Mean TFF in the with-AI condition was significantly shorter than both the pre-AI and without-AI conditions (both $p<.001$)

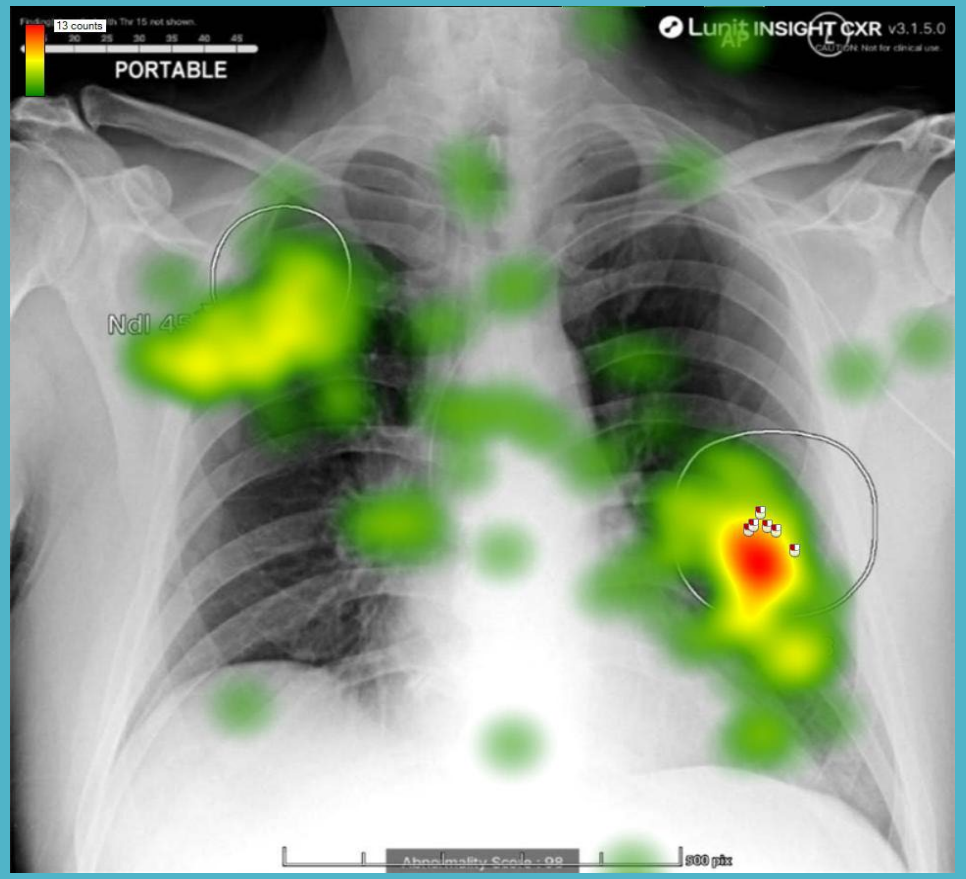
# Attention allocation- images with AI prompts

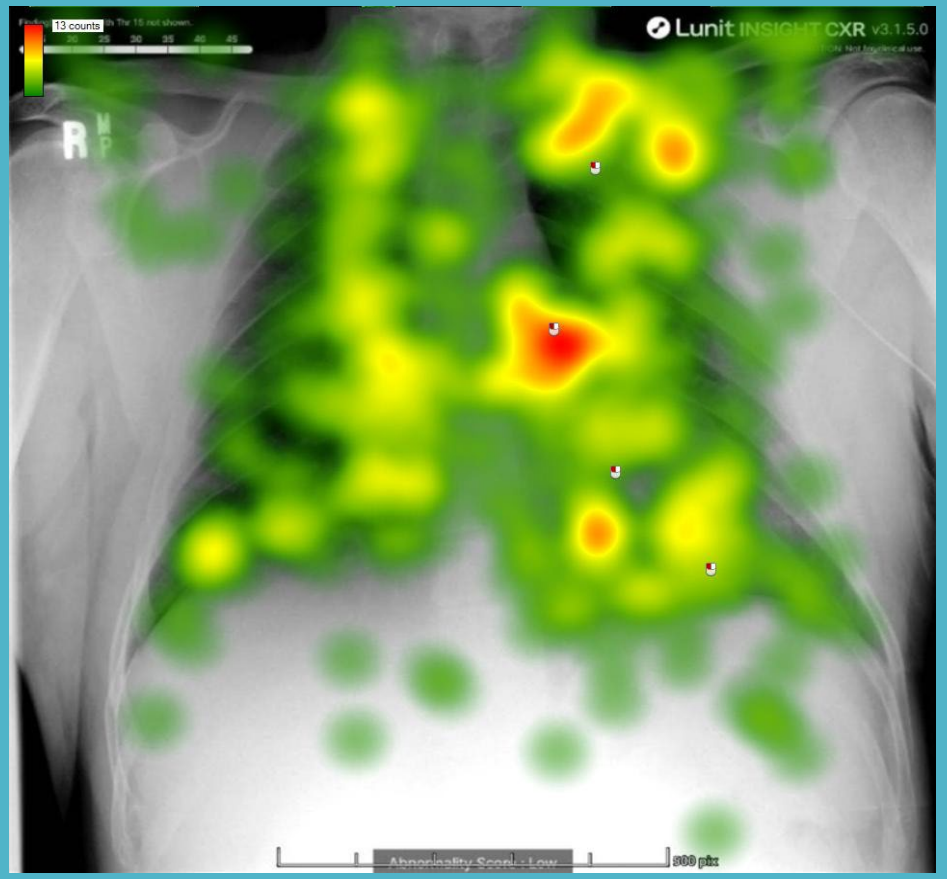
- Fixation count beyond AI prompt was significantly higher than fixation count on AI prompt (+3.19, *p*<.001)
- Fixation length on AI prompt was slightly higher than fixation length beyond AI prompt (+0.15s, *p*=.454)



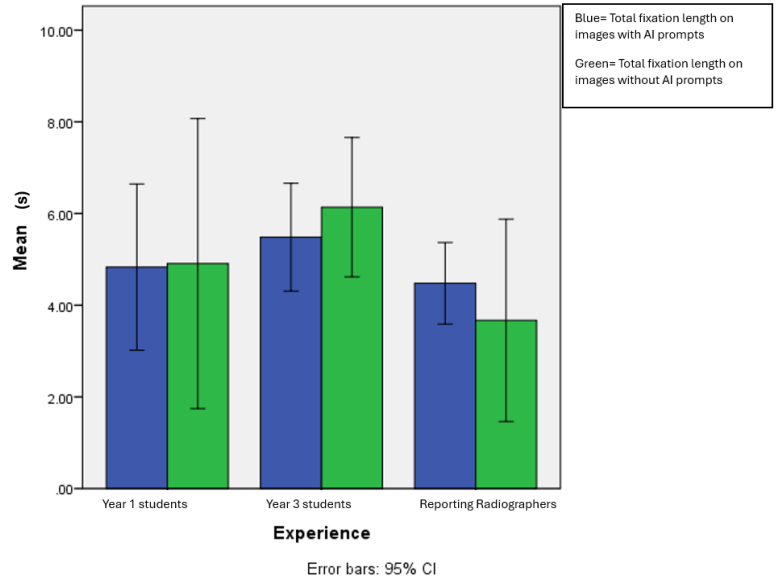



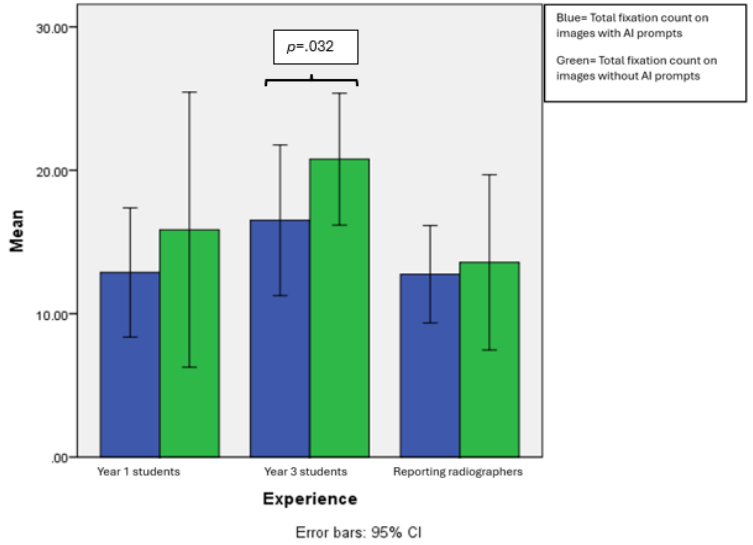
# Images with prompts vs images without (all participants)

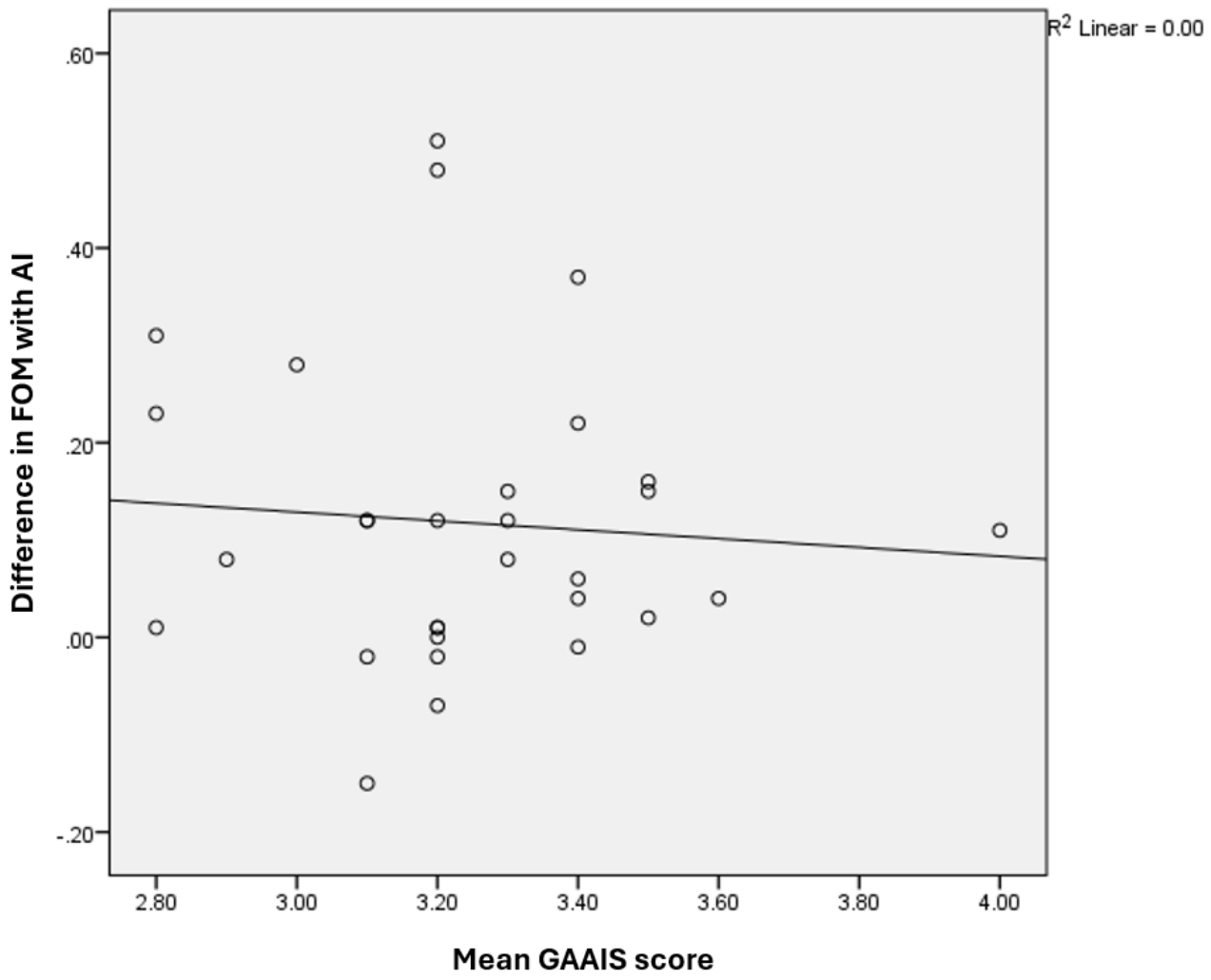


- Fixation count on images without prompts was higher than fixation count on images with prompts (+3.1, *p*=.059)
- For Year 3 students, the difference was statistically significant (+4.25, *p*=.032)
- Fixation length on images without prompts was higher than fixation length on images with prompts (+0.15s, *p*=.954)
- Observers less susceptible to errors of omission?






# Attitudes towards AI

- Year 3 students held the most positive attitude towards AI technology. However, Kruskal-Wallis test revealed that the difference between group GAAIS scores was non-significant (*p*=.070)
- Spearman's rank correlation test revealed that there was no relationship between mean GAAIS score and the difference in FOM with AI ($r_s$=-0.11, *p*=.954)

# Experiment 2- Confirmation bias in observer performance during an AI-assisted pulmonary nodule detection task: An eye tracking study

# Method

- Within subjects design- confirmation bias trial and control
- Sample will consist of Year 3 radiography students, radiographers and reporting radiographers
- Confirmation bias trial- initial 10 cases will be high human-AI agreement cases based on the findings of experiment 1
- Participants will be required to localise any suspicious nodules with a mouse click and to provide a confidence rating from 1-5 on both the initial image and AI image

Is there a statistically significant difference in agreement fraction/switch fraction between trials?

Is there a statistically significant difference in FOM between trials?

Is there any difference in visual search behaviour across the two trials? Eg fixation count, fixation length on AI image

| Participant | AF- CB Trial | AF-Control Trial | SF- CB Trial | SF- Control Trial |
|---|---|---|---|---|
| 11 | 0.87 | 0.6 | 0.31 | 0.17 |
| 12 | 0.73 | 0.73 | 0.55 | 0.45 |
| 13 | 0.8 | 0.8 | 0.5 | 0.58 |
| 14 | 0.67 | 0.7 | 0.15 | 0.1 |
| 15 | 0.67 | 0.67 | 0.35 | 0.45 |
| 16 | 0.63 | 0.5 | 0.05 | 0.13 |
| 19 | 0.63 | 0.87 | 0.37 | 0.42 |
| 20 | 0.63 | 0.7 | 0.42 | 0.38 |
| 21 | 0.8 | 0.6 | 0.5 | 0.33 |
| 3 | 0.6 | 0.63 | 0.39 | 0.21 |
| 4 | 0.7 | 0.73 | 0.1 | 0.23 |
| 5 | 0.57 | 0.33 | 0.41 | 0.3 |
| 6 | 0.47 | 0.43 | 0.21 | 0.15 |
| 8 | 0.57 | 0.67 | 0.18 | 0.25 |
| 18 | 0.67 | 0.73 | 0.4 | 0.32 |
| 1 | 0.83 | 0.73 | 0.44 | 0.36 |
| 10 | 0.73 | 0.7 | 0.23 | 0.29 |
| | | | | |
| Average | 0.68 | 0.65 | 0.33 | 0.30 |

# Preliminary results- Year 3 students

Across the first 10 cases:

CB trial AF= M= 0.91 (SD= 0.10)
Control trial AF= M= 0.45 (SD= 0.17)

Paired samples t-test= $t(16)= 8.79$, $p<.001$

CB trial SF= M= 0.10 (SD= 0.08)
Control trial SF= M= 0.58 (SD= 0.27)

Paired samples t-text= $t(16)= -7.18$, $p<.001$

# Thanks for listening, any questions?