

Looking without seeing or not believing your eyes?

An eye-tracking study on diagnosing X-rays

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Introduction

- Diagnostic errors in radiology are not uncommon
- To reduce the number of diagnostic error, insight into the causes of those errors is crucial.

Aims

- Study the effect of clinical information on radiologists' diagnostic process
- Examine the causes of missed abnormalities in a diverse sample of chest X-rays

Setting

- Realistic setting for X-ray viewing in the psychology laboratory
 - Realistic case mix
 - High resolution computer screen
 - Possibility to adjust brightness and contrast
 - Radiologists could dictate their findings

Methods

- Experimental eye-tracking study
- 25 radiologists each diagnosed 48 chest X-rays
 - 12 without abnormalities
 - 24 with one abnormality
 - 12 X-rays with the clinical information **matching** the abnormality
 - 12 X-rays with the clinical information **mismatching** the abnormality
 - 12 with two abnormalities
 - The clinical information matched one of the two abnormalities
- To analyze the eye-tracking data regions of interests (ROI) were determined apriori (by experts)
- The error types were determined based on the distribution of fixation durations on the correctly diagnosed abnormalities

Results – Effect of clinical information

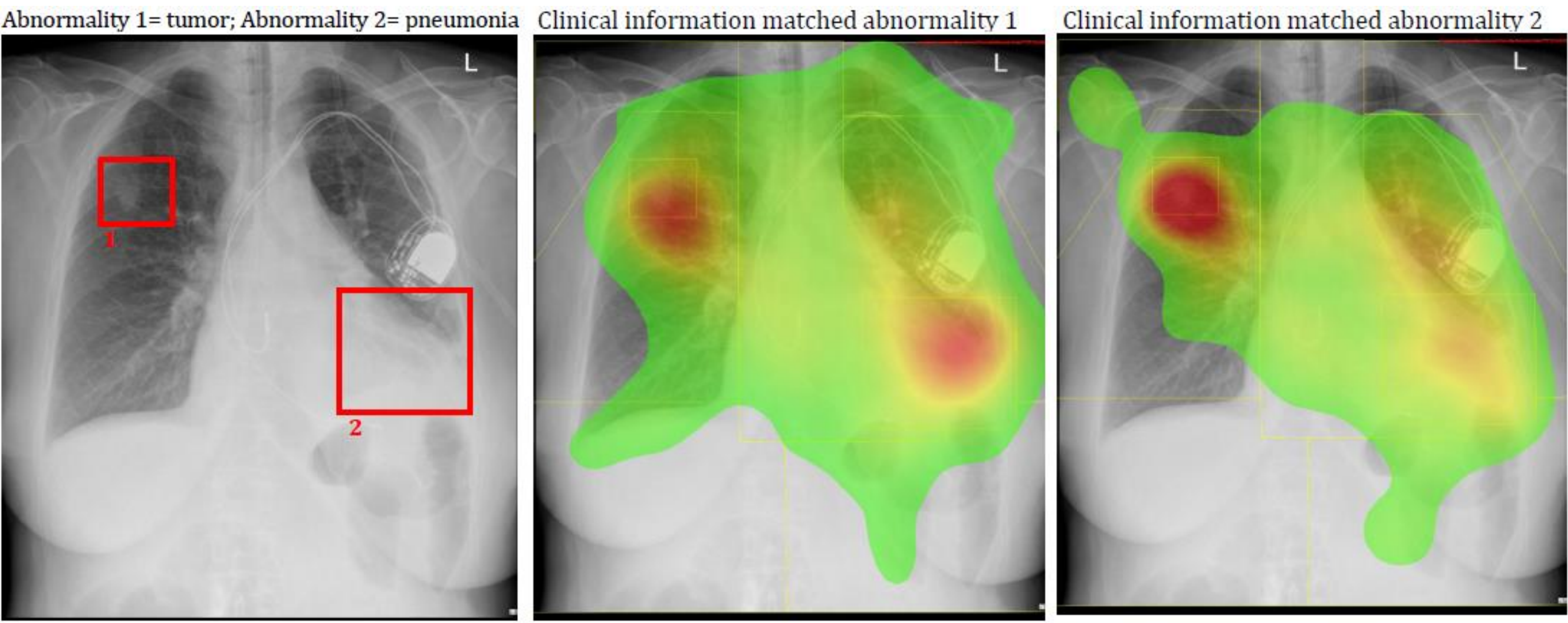
- There was a significant effect of clinical information on the number of reported abnormalities ($p < 0.005$)

One abnormality	Matching abnormality (N=300)	Mismatching abnormality (N=300)	Total (N=600)
True positives (TP)	201 (70.7%)	174 (58.0%)	386 (64.4%)
False negatives (FN)	72 (24.0%)	105 (35.0%)	177 (29.5%)
False interpretations (FI)	15 (5.0%)	21 (7.0%)	36 (6.0%)
Missing	1 (0.3%)	0 (0.0%)	1 (0.1%)

Two abnormalities	Matching abnormality (N=300)	Mismatching abnormality (N=300)	Total (N=600)
True positives (TP)	198 (66.0%)	172 (57.3%)	370 (61.7%)
False negatives (FN)	92 (30.7%)	119 (39.7%)	211 (35.2%)
False interpretations (FI)	9 (3%)	8 (2.7%)	17 (2.8%)
Missing	1 (0.3%)	1 (0.3%)	2 (0.3%)

Results – Example

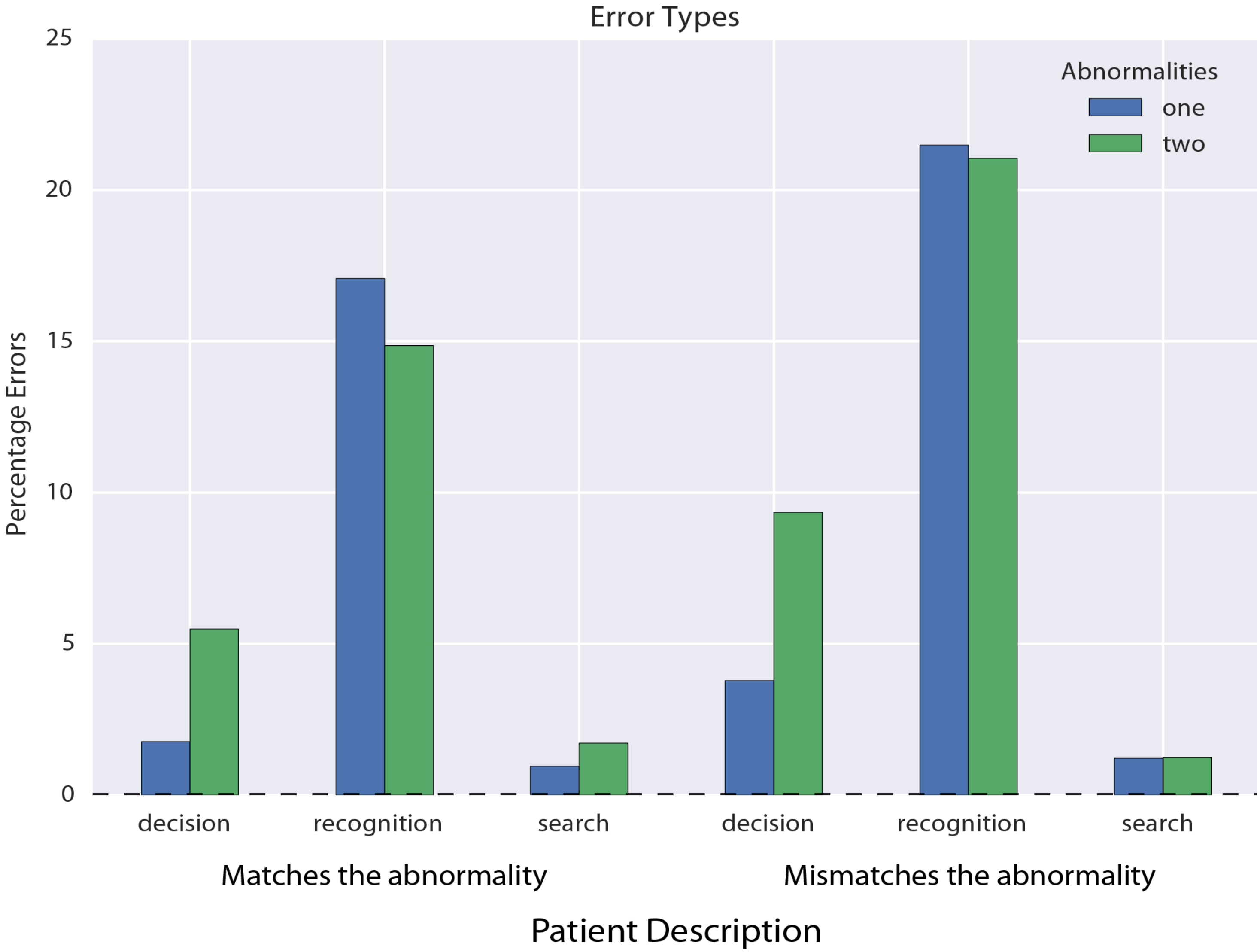
Figure 1. Example of fixation maps



Results – Causes

- Overall, recognition errors were the most common (74.5%) followed by decision errors (20.4%) and search errors (5.1%)

Figure 2. Error types of fixation maps for the match and mismatch conditions



- Significant interaction between the number of abnormalities and the error type ($p < .05$)**
 - more decision errors in the two abnormality cases (14.8%) than in the one abnormality cases (5.6%)
- Significant interaction between the clinical information and the error type ($p < .05$)**
 - More decision errors for mismatch vs match (13.1% vs. 7.3%)
 - More recognition errors for mismatch vs match (42.5% vs. 31.9%)

Discussion

Looking without seeing?

- Diagnostic errors are primarily due to failure in recognizing the abnormality that is being fixated
- Mismatching clinical information (diverting attention to something else) increases the number of recognition errors

Not believing your eyes?

- The presence of a second abnormality leads to discarding clinically relevant information even when the radiologist looked at the abnormality (increase in decision errors)