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

1. Study the effect of clinical information on radiologists’ diagnostic process
2. 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)

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

<table>
<thead>
<tr>
<th>Two abnormalities</th>
<th>Matching abnormality (N=300)</th>
<th>Mismatching abnormality (N=300)</th>
<th>Total (N=600)</th>
</tr>
</thead>
<tbody>
<tr>
<td>True positives (TP)</td>
<td>198 (66.0%)</td>
<td>172 (57.3%)</td>
<td>370 (61.7%)</td>
</tr>
<tr>
<td>False negatives (FN)</td>
<td>92 (30.7%)</td>
<td>119 (39.7%)</td>
<td>211 (35.2%)</td>
</tr>
<tr>
<td>False interpretations (FI)</td>
<td>9 (3.0%)</td>
<td>8 (2.7%)</td>
<td>17 (2.8%)</td>
</tr>
<tr>
<td>Missing</td>
<td>1 (0.3%)</td>
<td>1 (0.3%)</td>
<td>2 (0.3%)</td>
</tr>
</tbody>
</table>

Results – Causes

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

Discussion

Looking without seeing?
  ➢ Diagnostic errors are primarily due to failure in recognizing the abnormality that is being fixed
  ➢ 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)